HYDROGEOLOGICAL INVESTIGATION INTERIM REPORT

FORMER P.R. MALLORY PLANT SITE

Crawfordsville, Indiana

HYDROGEOLOGICAL INVESTIGATION
INTERIM REPORT

FORMER P.R. MALLORY PLANT SITE
Crawfordsville, Indiana

March 1987
Ref. No. 1916

CONESTOGA-ROVERS & ASSOCIATES

TABLE OF CONTENTS

		Page
1.0	INTRODUCTION	1
2.0	REGIONAL SETTING	2
	2.1 PHYSIOGRAPHY	2
	2.2 GEOLOGY	3
	2.2.1 Regional Setting	3
	2.2.2 Site Stratigraphy	5
	2.3 HYDROGEOLOGY	5
	2.4 GROUNDWATER USE	6
3.0	FIELD INVESTIGATIONS	8
	3.1 SCOPE	8
	3.2 DRILL SITE GEOPHYSICAL SURVEYS	8
	3.3 GROUNDWATER MONITORING WELL INSTALLATION	9
	3.3.1 Drilling Procedures	10
	3.3.2 Well Installation Procedures	11
	3.3.3 Well Development	13
	3.3.4 Equipment Cleaning	14
	3.3.5 Health and Safety	15
	3.4 HYDRAULIC CONDUCTIVITY DETERMINATIONS	16
	3.5 GROUNDWATER SAMPLING	17
	3.6 HYDRAULIC MONITORING	18
	3.7 GEOPHYSICAL SURVEY	19
4.0	SITE SETTING	22
	4.1 PHYSIOGRAPHY	22
	4.2 GEOLOGY	22
	4.2.1 Till Unit	23
	4.2.1.1 Upper Weathered Zone	24
	4.2.1.2 Discontinuous Granular Horizons	24
	4.2.2 Sand and Gravel Unit	25
	4.3 HYDROGEOLOGY	26
	4.3.1 Till Aquitard	27

TABLE OF CONTENTS

		Page
	4.3.1.1 Weathered Till Aquitard	28
	4.3.1.2 Isolated Permeable Horizons	28
	4.3.2 Sand and Gravel Aquifer	29
	4.3.3 Groundwater Flow System	30
5.0	GROUNDWATER CHEMISTRY	32
	5.1 PCB	32
	5.2 VOLATILE ORGANIC COMPOUNDS	34
	5.3 METALS	34
	5.4 GENERAL CHEMISTRY	34
	5.5 DIOXIN	35
6.0	SUMMARY	36

LIST OF TABLES

		Following Page
TABLE 2.1	SUMMARY OF WATER WELL INFORMATION	5
TABLE 3.1	OBSERVATION WELL CONSTRUCTION DETAILS	13
TABLE 3.2	SUMMARY OF WELL DEVELOPMENT PARAMETERS	13
TABLE 3.3	SUMMARY OF GROUNDWATER SAMPLING PARAMETERS	17
TABLE 3.4	WATER LEVEL DATA	18
TABLE 4.1	SUMMARY OF GRAIN SIZE DISTRIBUTION ANALYSES	26
TABLE 4.2	SUMMARY OF RESPONSE TESTS	26
TABLE 5.1	GROUNDWATER CHEMISTRY RESULTS - PCB	32
TABLE 5.2	GROUNDWATER CHEMISTRY RESULTS - VOLATILE ORGANIC COMPOUNDS	34
TABLE 5.3	GROUNDWATER CHEMISTRY RESULTS - METALS	34
TABLE 5.4	GROUNDWATER CHEMISTRY RESULTS - GENERAL CHEMISTRY	35
TABLE 5.5	GROUNDWATER CHEMISTRY RESULTS - DIOXINS AND FURANS	35

LIST OF FIGURES

FIGURE 1.1	SITE LOCATION	1
FIGURE 2.1	BEDROCK TOPOGRAPHY AND REGIONAL HYDROGEOLOGY	4
FIGURE 2.2	WATER WELL LOCATIONS	5
FIGURE 2.3	REGIONAL GEOLOGIC CROSS-SECTION	5
FIGURE 3.1	OBSERVATION WELL LOCATIONS	8
FIGURE 4.1	STRATIGRAPHIC CROSS-SECTION	22
FIGURE 5.1	GROUNDWATER GEOCHEMICAL FACES	35

LIST OF APPENDICES

APPENDIX A BOREHOLE STRATIGRAPHIC LOGS

APPENDIX B GRAIN SIZE DISTRIBUTION CURVES

APPENDIX C RESPONSE TEST DATA

APPENDIX D MAGNETOMETER SURVEY DATA

LIST OF PLANS

PLAN 1 MAGNETOMETER SURVEY

1.0 INTRODUCTION

The initial hydrogeological investigation of the Former P.R. Mallory Plant Site (Figure 1.1) was designed to identify the impact, if any, of past site operations on the natural geologic conditions. During this phase of the investigation the objectives were:

a) to characterize the site geology and identify potential contamination migration pathways;

b) to determine the lateral and vertical direction of groundwater flow, as well as the flow velocity;

c) to determine the extent and degree of groundwater contamination, if any, and the potential for lateral and vertical migration of contaminants; and

d) to identify additional work that would be required to complete the study objectives.

This interim report summarizes the methods and results of the research, field investigations and data interpretation.

MAP OF INDIANA SHOWING COUNTIES

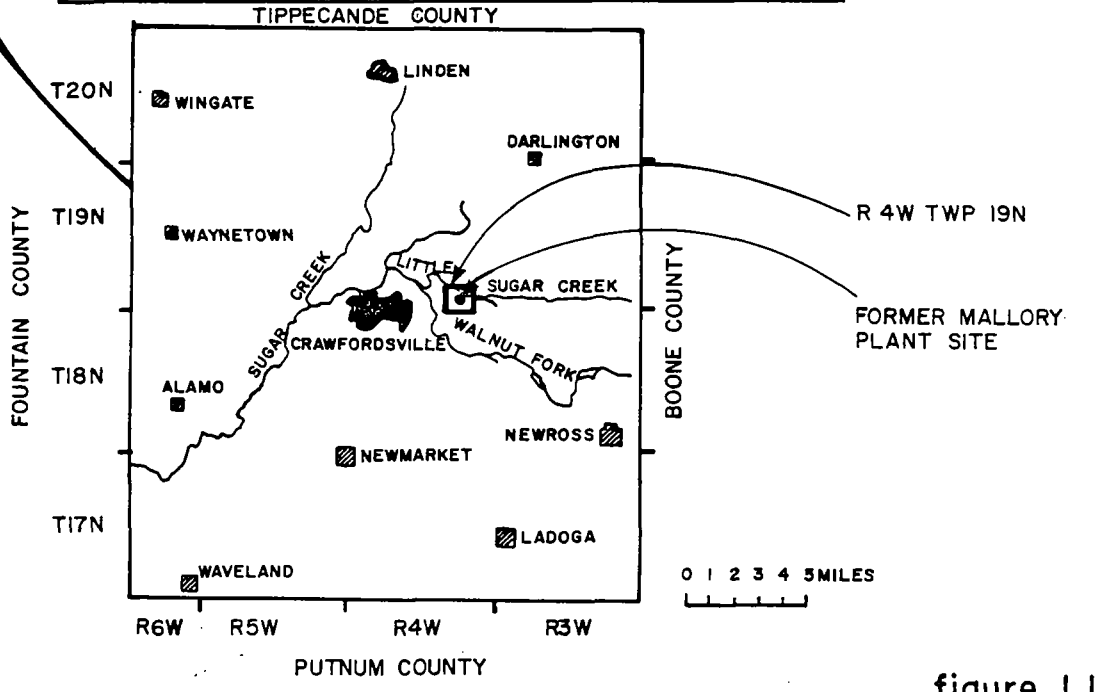


figure 1.1

SITE LOCATION

Crawfordsville, Indiana

CRA

1916-31/03/87

2.0 REGIONAL SETTING

2.1 PHYSIOGRAPHY

Montogomery Country occurs within the Tipton Till Plain physiographic province (Cable and Robison, 1974). This province is typified by flat to gently sloping topography as is common of extensive glacial till plains. Topographic relief is evident primarily where modern rivers and streams have eroded narrow channels and gullies within the till plain. Bedrock is occasionally exposed within major stream courses.

In the vicinity of Crawfordsville drainage is accomplished by Sugar Creek and it tributaries. The watershed divide of this drainage system occurs 20 to 30 miles east of Crawfordsville. Flow within this watershed is generally westward. The principal tributaries to Sugar Creek east of Crawfordsville are, Little Sugar Creek, Lye Creek and Walnut Fork. Minor ravines and gullies provide intermittent flow paths towards these creek systems. The ultimate discharge of the Sugar Creek drainage basin is to the Wabash River, 30 miles West of Crawfordsville.

2.2 GEOLOGY

2.2.1 Regional Setting

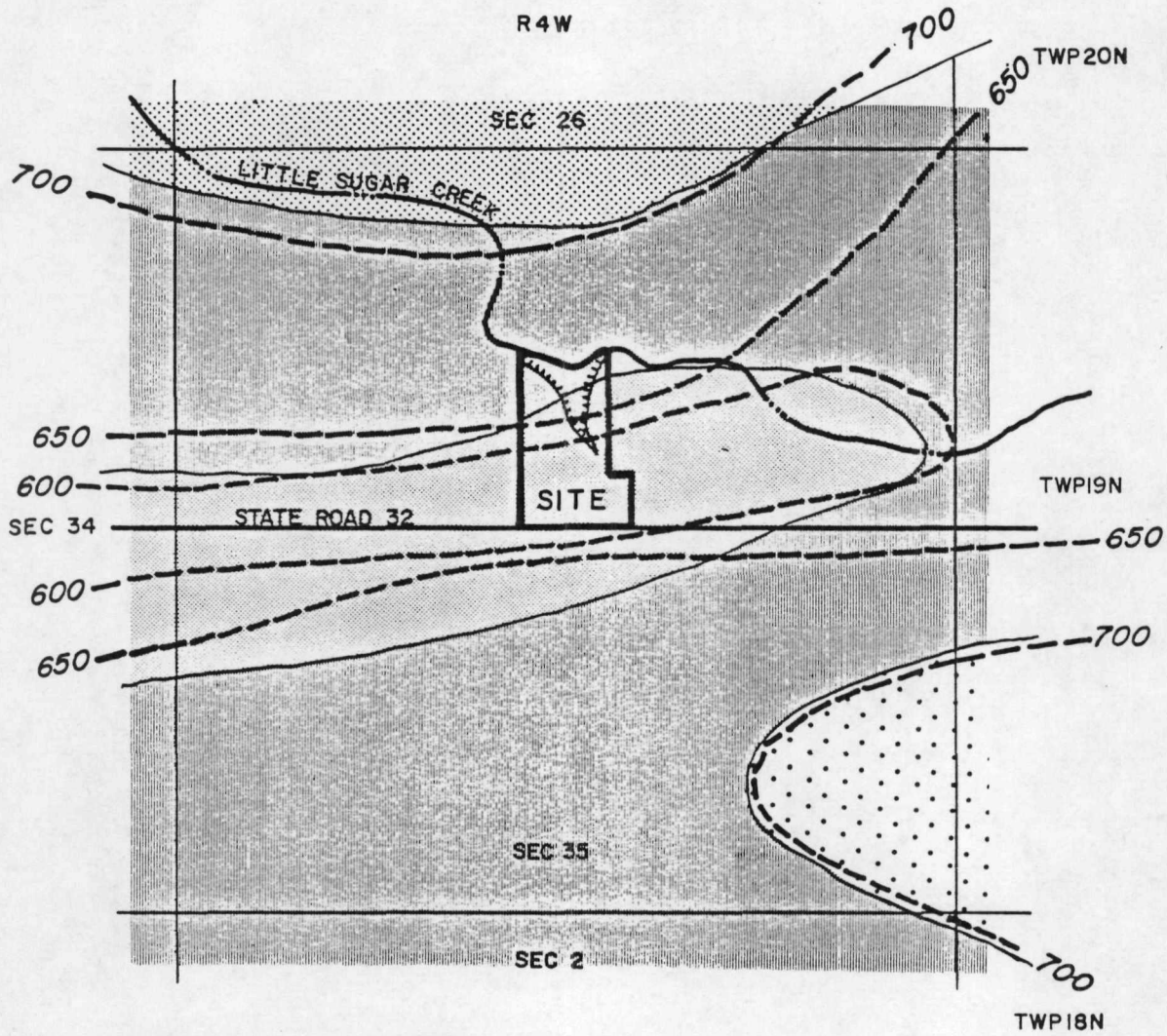
The surficial geology of Northern Indiana has been created entirely by Wisconsin age glaciation. The southern extent of Wisconsin glaciation occurs approximately 40 miles south of Montgomery County. The surficial geology as presented by Wayne et al. (1966) demonstrates the typical geologic environment which occurs near the extent of glaciation. The principal feature of the glacial geology is an extensive ground moraine which covers the entire map area. Large areas of end moraine deposits occur in connected, arcuate patterns trending northwest to southeast. (Wayne 1965).

In the vicinity of Crawfordsville the principal glacial feature is the Crawfordsville moraine which occurs between the northwest corner of Montgomery County and Crawfordsville. This moraine is considered to mark the limit of the second advance of Wisconsin glaciation. Associated with the end moraine complex are numerous deposits of sand, silt and gravel referred to as ice-contact stratified drift. These deposits are generally discontinuous and mixed with glacial till inclusions as they are formed by glacial meltwaters in the presence of melting ice. Also common in this area are sand and gravel deposits formed within modern

drainage channels. Many of these deposits consist of outwash materials formed by flow of glacial meltwaters away from the ice margins. These outwash deposits differ from ice-contact stratified drift by being laterally continuous and containing well sorted materials.

Information obtained from Cable and Robison (1974) indicates that a pronounced bedrock valley is buried by the thick sequence of glacial sediments in the vicinity of the site. (Figure 2.1). The source of information used to construct this map is not presented. These bedrock valleys are filled with sand and gravel sediments from older glacial events, and are referred to as valley-train deposits. These valley-train deposits form an extensive ancient drainage network for glacial meltwaters.

The uppermost unit in the Crawfordsville area consists of Mississippian age limestones, siltstones and shales of the Borden Group. The presence of softer formations such as shale and siltstone may be reflected in part by the nature of the bedrock topography mentioned above.



LEGEND

GROUNDWATER SUPPLY UNITS

- MISSISSIPIAN SHALES & SILTSTONES (BORDEN GP)
- DISCONTINUOUS VALLEY TRAIN DEPOSITS (SAND & GRAVEL)
- VALLEY TRAIN DEPOSITS (SAND & GRAVEL)
- SAND LENSES WITHIN TILL DEPOSITS

BEDROCK TOPOGRAPHY CONTOURS

N

0 1/8MI. 1/4MI.

SOURCE : CABLE & ROBINSON (1974)

figure 2.1

BEDROCK TOPOGRAPHY
& REGIONAL HYDROGEOLOGY
Crawfordsville, Indiana

CRA

1916-31/03/87

2.2.2 Site Stratigraphy

In order to better assess the stratigraphy of the Site, the water well records within a half mile radius of the Site were obtained. The approximate location of the water wells are presented on Figure 2.2. The contents of the water well records are summarized on Table 2.1. A regional cross-section has been constructed based upon the lithological descriptions provided within the well records and is shown on Figure 2.3. The section location is shown on Figure 2.2.

The bedrock surface has not been identified in the vicinity of the site. The inferred position of the bedrock surface is shown on Figure 2.3, and is based on the bedrock topography presented in Cable and Robison (1974).

2.3 HYDROGEOLOGY

The hydrogeology of Montogomery County has been outlined by Cable and Robison, (1974). Water supplies are obtained from three distinct sources. These are as follows:

1) small, isolated, discontinuous aquifers contained within the thick impermeable glacial till sequences;

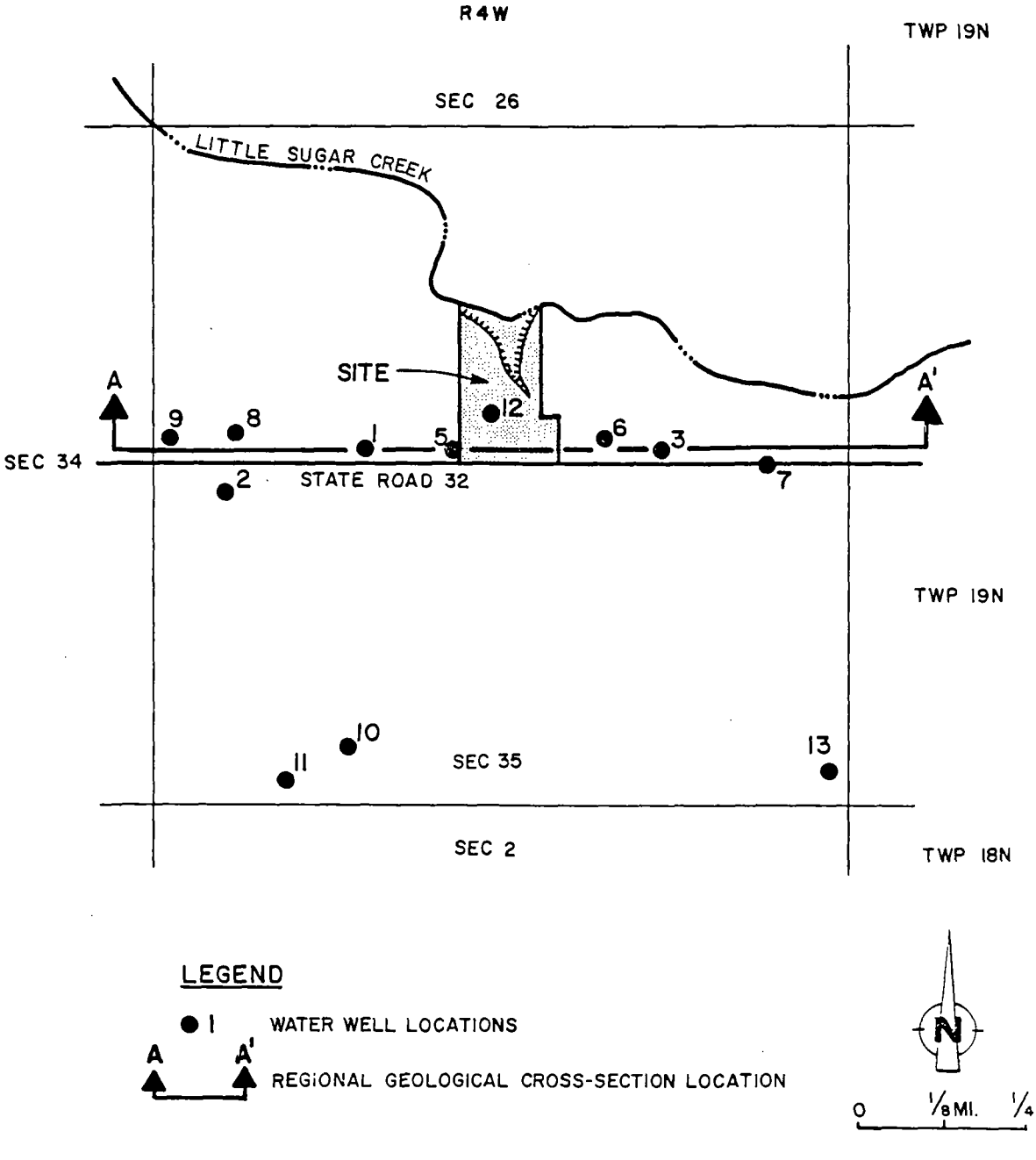


figure 2.2

WATER WELL LOCATIONS
Crawfordsville, Indiana

CRA

1916-31/03/87

TABLE 2.1

SUMMARY OF WATER WELL INFORMATION

SECTION 35 - TWP 19N - RANGE 4W - MONTGOMERY COUNTY

1916

DESIGNATION	LOCATION (FEET)	GROUND EL. FEET AMSL	PROPERTY OWNER	DATE INST.	TOTAL DEPTH (FEET B.G.S.)	DIA. INCHES	STATIC LEVEL (FEET B.G.S.)	TESTED	USE	COMMENTS
1	1,600 E, 2,500 S	790 +	PEPSI COLA	20/12/72	122	4"	40' B.G.S.	1 hr/5gpm	IND	
2	2,500 N, 550 E	785	SUGAR CR. PRIMATIVE BAPTIST	10/7/64	52	4"	35	1/2 hr/10gpm	DOM	
3	1,400 W, 2,500 S	785	C. COLEMAN	7/11/73	67	4"	49	1/2 hr/10gpm	DOM	
4	SW-SW-NE	NM	DAWSON MFG.	1950	116	6"	N.M.	/10gpm	IND/DOM	FOR MUN. USE - SMARTSBURG
5	2,300 E, 2,800 N	790	TERRA KNIFE	24/11/61	117	4"	48	1 hr/10gpm	IND	
6	2,900 N, 1,850 E	795	SURFACE & RUSH	11/62	118	4"	48	1/2 hr/10gpm	IND	
7	4,700 E, 2,700 N	800	TOM SLAVENS	8/61	75	4"	50	1 hr/10gpm	DOM	
8	4,700 W, 2,950 N	798	L.D. JONES	23/8/63	112	4"	56	1/2 hr/5gpm	DOM	
9	5,200 W, 2,950 N	800	SERVICE LUMBER/STRADLER	8/8/63	114	4"	70	1/2 hr/10gpm	DOM	
10	1,500 E, 50 N	790	KRIK	19/10/59	92	4"	45	1 hr/10gpm	DOM	
11	1,000 W, 200 N	790	C.O. DELL 61-9	16/2/61	101	4"	56	10 hr/10gpm	DOM	
12	2,600 E, 3,070 N	790	P.R. MALLORY - SMARTSBURG PLANT	8/12/56	128	8"	50	5 hr/165gpm	IND	100gpm PUMP INSTALLED
13	100 W, 300 N	820 +	ROBERT MILES	26/3/71	170	4"	65	2 hr/5gpm	DOM	SHALE @ 107 FT.

continued....

TWP19N RANGE 4W SECTION 35

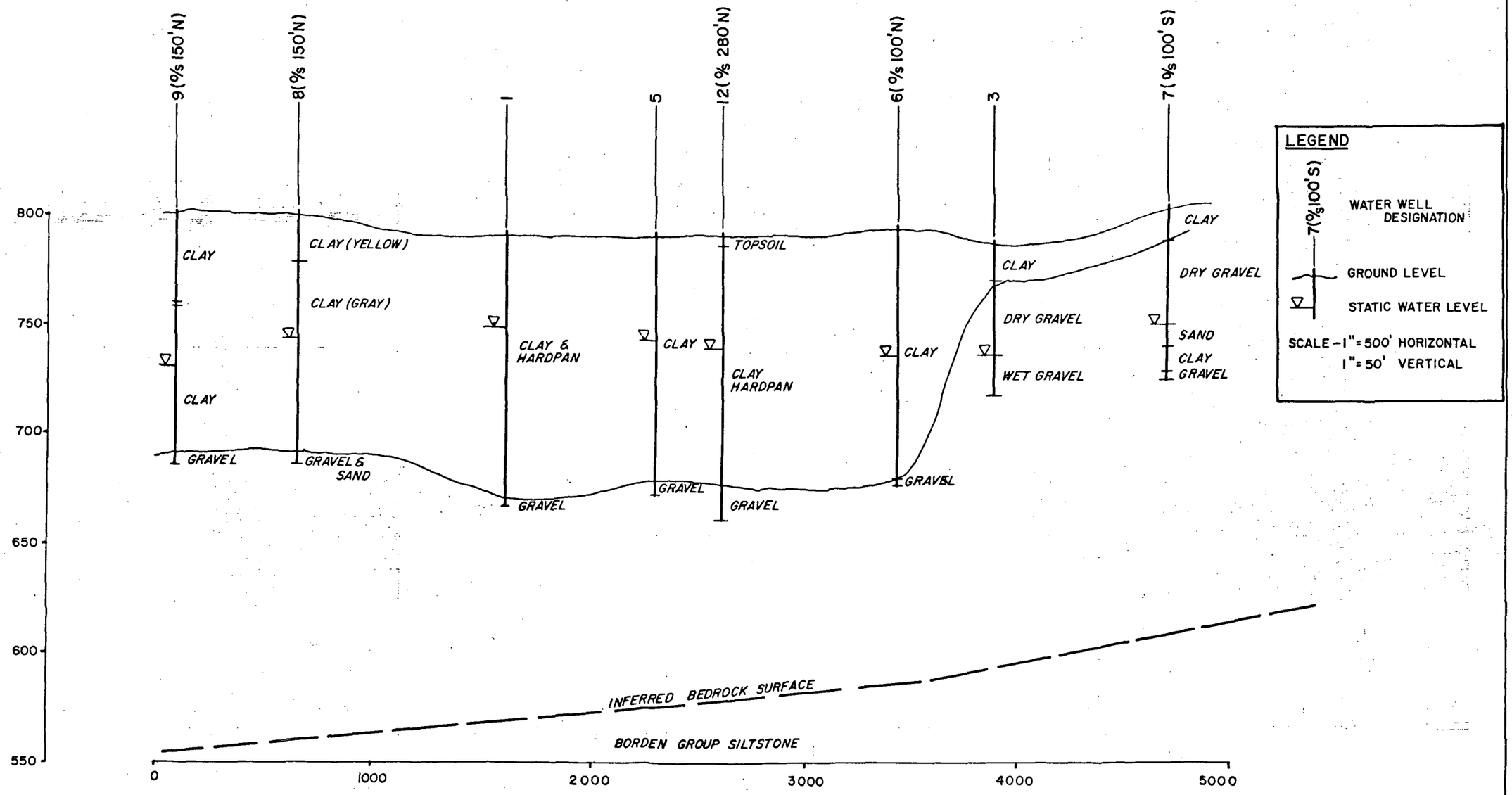
A WEST

A' EAST

2800' NORTH OF SOUTH TWP LINE

TERRA PRODUCTS — DURACELL INT. — SUPERIOR MOVING

SITE



LEGEND

7(% 100'S) — WATER WELL DESIGNATION

GROUND LEVEL

STATIC WATER LEVEL

SCALE – 1" = 500' HORIZONTAL
1" = 50' VERTICAL

figure 2.3

REGIONAL GEOLOGICAL CROSS-SECTION A-A'
Crawfordsville, Indiana

CRA

1916-31/03/87

2) continuous and discontinuous sand and gravel deposits occupying buried bedrock valleys and vertically confined by glacial till sequences; and

3) permeable bedrock formations.

Comparison of this work with the available water well records indicates that the major aquifer in the vicinity of the site is the continuous sand and gravel deposits. Figure 2.3 indicates that there is a relatively uniform potentiometric surface within the aquifer. However, sufficient data is not available to determine the flow directions. Also, there is no information available concerning the water quality of this aquifer.

No data was available on the shallow groundwater flow system.

2.4 GROUNDWATER USE

As previously stated, water well records were obtained from the Division of Water, Indiana Department of Natural Resources for Section 35, Township 9N, Range 4W, Montgomery County. The pertinent information for these wells are summarized on Table 2.1.

All wells, except Well 13, are completed within the deep continuous valley train sand and gravel aquifer. Well 13 is completed in bedrock. There are no wells on record that are completed in the permeable zones within the glacial till.

It appears, therefore, that past site activities would have little impact on existing groundwater users.

3.0 FIELD INVESTIGATIONS

3.1 SCOPE

The field investigations required to meet the objectives of the initial hydrogeological investigation consisted of drilling boreholes to define the site stratigraphy, installing observation wells within permeable strata, field testing to determine hydraulic conductivity, and collecting representative groundwater samples from these wells. The procedures employed to complete these tasks are outlined in the following sections.

A total of seven observation wells were completed at five locations about the site as illustrated on Figure 3.1.

A geophysical survey of the site was also completed in conjunction with Phase I construction activities and is discussed in Section 3.7.

3.2 DRILL SITE GEOPHYSICAL SURVEYS

Prior to commencing drilling operations, a magnetometer survey was conducted around each proposed borehole site to confirm the absence of buried refuse. The

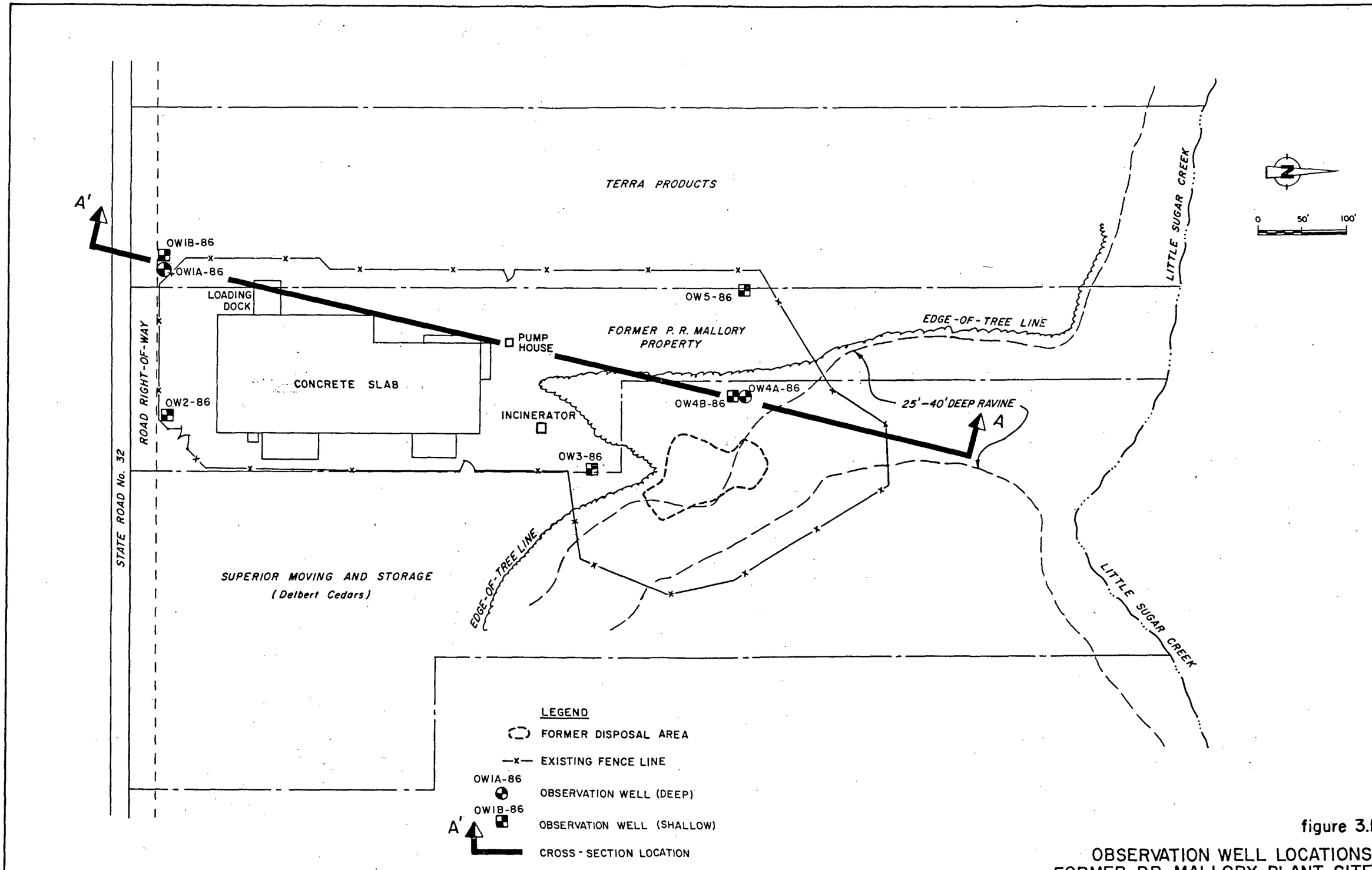


figure 3.1

OBSERVATION WELL LOCATIONS
FORMER P.R. MALLORY PLANT SITE
Crawfordsville, Indiana

CRA

1916-31/03/87

magnetometer used in this survey was a McPhar Proton Magnetometer, Model GP-81. This unit consisted of an omni directional, noise cancelling torroidal coil sensor mounted upon a six-foot aluminum rod, and a pre-calibrated instrument. This type of magnetometer measures the total magnetic field at each station. Aberrations in the magnetic field can be identified by contouring data points in plan view, or plotting results for each survey line. Sensitivity of the instrument is in the range of one gamma. Duplicate readings at each station agree well unless strong magnetic gradients are present. These gradients can be created by fences, vehicles, power lines and additional metal or electric objects.

The magnetometer survey at each location was comprised of a 20 x 30-foot grid with stations every five feet. Two readings were made at each station and the average was contoured to identify any anomalies.

The results of these surveys indicated that all sites were clear of buried refuse that could hinder the drilling operations.

3.3 GROUNDWATER MONITORING WELL INSTALLATION

The monitoring well installation program was initiated on December 10, 1986. Geotechnology Drilling

Services Inc. of St. Louis, Missouri was contracted to complete the installation and development of the monitoring wells. The installation of the seven monitoring wells was completed on December 22, 1986. Well development was undertaken between January 5, 1987 and January 8, 1987.

3.3.1 Drilling Procedures

Boreholes for installation of observation wells were advanced using a CME-55 drilling rig and 4 1/4-inch ID hollow stem augers. The borehole diameter is approximately 9 1/4-inch. All cuttings from these borings were stored for future disposal. The initial intention of the study was to continuously sample the upper 15 feet of overburden and sample with a split spoon sampler at five-foot intervals for the remainder of the borehole. The nature of the glacial till necessitated a change to continuous sampling of the entire borehole as auger refusal was obtained at shallow depth using conventional drilling methods. Continuous samples were obtained using a CME continuous sampling system which provides a 3 1/2-inch diameter undisturbed core for each five-foot run. The use of the continuous sampling system provides accurate definition of stratigraphy.

The nature of the materials encountered at depth required some addition of fluids to complete the deep installations to the desired depths. Sand and gravel was removed from within the augers by applied water pressure, using water from municipal sources. Sand and gravel samples from depth were collected using a standard stainless steel split spoon sampler.

The shallow borehole at location OW1-86 was advanced by conventional augering and driving a split spoon at the desired screen interval.

Soil samples from each run were visibly logged and described to define the stratigraphic sequence at each location. Representative samples from each run, and of discrete units, were stored on site for future reference. Stratigraphic and instrumentation logs are presented in Appendix A.

3.3.2 Well Installation Procedures

The observation wells were placed through the annulus of the hollow stem augers. The wells consist of five feet of 2-inch diameter, type 304, stainless steel, no. 10 slot well screen, and sufficient 2-inch diameter, type 304 stainless steel, schedule 5, flush-joint riser pipe to

provide suitable stickup. All joints in the well assembly were Johnson environmental threads and include a rubber "O" ring to ensure a complete seal.

The borehole annulus around the well screen was filled with chert sand supplied by Winter Brothers Sand Company. The grading curves for sand size WB-35 is provided in Appendix B. Sand was introduced to the borehole slowly through the augers. Time was allowed for sand to settle out when a water column was present during installation. Upward flow within the water column was encountered during installation of sand packs in the deep wells and slowed the installation process. Natural sand packs were used when conditions proved too difficult for sand pack emplacement.

The sand packs were installed to a minimum depth of three feet above the well screen. A minimum two-foot thickness of bentonite pellets was placed above the sand pack. The bentonite pellets used were manufactured by Volclay and were 3/8 inch in diameter. In the deep boreholes where seal placement was hindered by the depth and water conditions, a bentonite seal was formed by pumping a thick slurry of bentonite mud into the borehole annulus via a tremie pipe.

The wells were then completed by filling the borehole annulus with a cement-bentonite grout mixture.

Type II portland cement was used along with three percent bentonite mud.

A six-inch lockable protective casing was grouted in place to permit easy access to the riser pipe.

Observation well construction details are presented on Table 3.1.

3.3.3 Well Development

All monitoring wells installed under the initial hydrogeological investigation were developed to a silt free or chemically stable condition prior to sampling the groundwater. This process involved removal of a volume of water equivalent to three to five well volumes, in addition to any water introduced during drilling. Measurements of conductivity were made following the removal of each well volume to demonstrate physical stability. All development waters were contained in drums for ultimate disposal following receipt of analytical results. A summary of the development parameters for each well is presented on Table 3.2.

The deep aquifer wells OW1A-86 and OW4A-86 were initially developed by air lift methods. This method consisted of inserting 100 feet of one-inch flexible PVC

TABLE 3.1

OBSERVATION WELL CONSTRUCTION DETAILS

Observation Well Designation	Ground Elevation (ft AMSL)	Reference Elevation (ft AMSL)	Total Depth (ft)	Screen Depth (ft BGS)	Screen Elevation (ft AMSL)	Sand Pack Depth (ft BGS)	Sand Pack Elevation (ft AMSL)	Date Completed
OW1A-86	794.7	798.08	118.1	112 - 117	682.7 - 677.7	103 - 118.1	691.7 - 676.6	Dec. 16/86
OW1B-86	794.9	797.49	19	13 - 18	781.9 - 776.9	10 - 19	784.9 - 775.9	Dec. 16/86
OW2-86	796.0	798.27	35	28 - 33	768 - 763	21 - 35	775 - 761	Dec. 17/86
OW3-86	792.7	794.72	47.2	30.5 - 35.5	762.2 - 757.2	27 - 36.5	765.7 - 756.2	Dec. 22/86
OW4A-86	789.9	792.61	113	107.4 - 112.4	682.5 - 677.5	103 - 113	686.9 - 676.9	Dec. 21/86
OW4B-86	790.4	792.27	43	36 - 41	754.4 - 749.4	32 - 43	758.4 - 747.4	Dec. 22/86
OW5-86	791.2	793.08	48.8	43 - 48	748.2 - 743.2	32.2 - 48.8	759 - 742.4	Dec. 18/86

NOTE: 1. BGS - Below Ground Surface
2. AMSL - Above Mean Sea Level

TABLE 3.2

SUMMARY OF WELL DEVELOPMENT PARAMETERS

Designation	Date	Water Level (ft)*	Sand Volume (gal)	Well Volume (gal)	Volume Removed (gal)	Conductivity (umhos)	Development Method	Comments
OW1A-86	5/1/87	35.66	9	22.4				
	6/1/87	36.22			9	NM	Air lift/Bail	Bailer stuck
	7/1/87	(90)			5 dry	NM	Bail	Very slow recharge
	8/1/87	109.77			3 dry	NM	Bail	A.M.
	8/1/87	(113)			2 dry	NM	Bail	P.M.
OW1B-86	5/1/87	7.4	5.4	7.4	7.5	150	Bail	Sandy
	6/1/87	8.04			7.5	355	Bail	A.M.
	6/1/87	8			7	360	Bail	P.M.
	7/1/87	8.4			7	NM		Trace silt
OW2-86	5/1/87	9.98	8.4	11.6	11	30	Bail	Sandy
		NM			11 dry	240	Bail	
		NM			13 dry	245	Bail	Trace silt
	6/1/87	11.24			3	NM	Bail	Lost bailer
	7/1/87	NM			8 dry	NM	Bail	
OW3-86	5/1/87	15.16	5.7	9.4	7 dry	235	Bail	
	6/1/87	NM			6 dry	185	Bail	
	6/1/87	NM			5 dry	260	Bail	
	7/1/87	19.58			5 dry	NM	Bail	

continued....

TABLE 3.2

SUMMARY OF WELL DEVELOPMENT PARAMETERS

Designation	Date	Water Level (ft)	Sand Volume (gal)	Well Volume (gal)	Volume Removed (gal)	Conductivity (umhos)	Development Method	Comments
OW4A-86	5/1/87	48.09	6	16				
	6/1/87	48.04			20	215	Air lift	Clear
		NM			20	215	Air lift	Cloudy
		NM			20	215	Air lift	Clear
		NM			20	215	Air lift	Clear
		NM			25	215	Air lift	Clear
	7/1/87	48.08			10	215	Bail	Clear
OW4B-86	5/1/87	22.18	6.6	10.3	10	225	Bail	
	5,6/1/87	25.08			10 dry	195	Bail	
	6/1/87	NM			6 dry	230	Bail	
	6/1/87	NM			12 dry	235	Bail	
	7/1/87	(25)			9 dry	210	Bail	
OW5-86	5/1/87	14.09	9.96	15.0	8 dry	240	Bail	
	6/1/87	32.58			7 dry	200	Bail	
	6/1/87	NM			2 dry	255	Bail	
	7/1/87	10			6 dry	NM	Bail	

NOTE:

( ) - represents approximate water level, not measured
NM - *not measured*

tubing and an air line into the well annulus. Pressurized air was then introduced into the system via a compressor, and water in the well annulus was discharged at surface. The removal rate for this system was on the order of four gallons per minute. OW1A-86 did not recharge upon removal of the water within the well annulus and the remainder of the development was completed by bailing. This well was bailed dry on three consecutive days prior to sampling. Air lifting of OW4A-86 produced 105 gallons within 30 minutes. No apparent drawdown was observed during this period. An additional 10 gallons was removed by bailing prior to sampling.

The shallow aquifer wells were developed by removing well water with steam cleaned, bottom loading PVC bailers on consecutive occasions. Water levels were monitored following development to provide an estimate of the in-situ hydraulic conductivity.

3.3.4 Equipment Cleaning

Precautions were taken during installation of monitoring wells to eliminate potential for cross-contamination between boreholes. The drill rig and all down hole equipment was steam cleaned prior to use on site, between each borehole, and prior to removal from site. The continuous sampler and split spoons were subjected to a

methanol-hexane-methanol-deionized water rinse prior to use in the upper 20 feet. The continuous sampler was washed with water prior to reuse at all other times.

Well construction materials including the stainless steel well screens and riser pipes were prepared for use by steam cleaning, followed by a methanol-hexane-methanol-deionized water rinse.

All equipment used for well development was steam cleaned prior to initial use. Stainless steel bailers were rinsed with methanol-hexane-methanol-deionized water prior to use in sampling.

3.3.5 Health and Safety

All field operations undertaken during the initial hydrogeological investigation were conducted under protection of Level C health and safety protocols. An exclusion zone with access via a health and safety trailer was set up to include most of the site area. Temporary exclusion zones were constructed around off-site work areas. Level C health and safety protocols included saranex coated disposable coveralls, rubber boots, cotton gloves, nitrile gloves and latex surgical gloves. All joints between suits and gloves and boots were sealed with duct tape. Respiratory

protection consisted of full face respirator with organic vapor cartridges and dust filters. Supervision of all health and safety activities was provided by a representative of Sevenson Containment Corporation. In addition to the on-site safety measures, all personnel were required to have complete physicals prior to and following on-site work.

3.4 HYDRAULIC CONDUCTIVITY DETERMINATIONS

The hydraulic conductivity of the geologic materials was estimated in two ways. Single well response tests were performed in all wells during recovery to determine the in situ hydraulic conductivity. Field data from the well response tests are presented in Appendix C. Hydraulic conductivity values were then calculated using the method of Hvorslev (1951). Also, representative samples of geologic materials were submitted to Geotechnology Inc. laboratory for determination of grain size distribution. Hydraulic conductivity values were estimated by the Hazen method as described in Freeze & Cherry (1979).

Additional laboratory hydraulic conductivity determinations within the glacial till were planned, however, the nature and hardness of the till prevented the collection of Shelby tubes.

3.5 GROUNDWATER SAMPLING

Round 1 groundwater samples were collected from the observation wells following initial well development. A summary of the sample locations and parameters is presented on Table 3.3. Due to the relatively slow recovery times, the wells were bailed dry and allowed to recover to a level that would permit sample collection. OW4A-86, installed within the aquifer unit, produced water without noticeable drawdown and more than five volumes were removed prior to sampling. OW1A-86 did not recover quickly and was bailed dry on three consecutive days, but did not reach an equilibrium level during the round 1 monitoring.

Groundwater samples were collected for analysis for Hazardous Substance List (HSL) volatiles, PCBs, metals and general chemistry. Samples were poured from stainless steel bailers cleaned according to the protocols outlined in Section 3.3.4. These samples were submitted for analysis to Wadsworth Alert Laboratories.

Groundwater samples for dioxin/furan analyses were collected from OW4B-86 and submitted to Hazleton Laboratories.

Additional samples for quality assurance/quality control (QA/QC) were also collected as

TABLE 3.3

SUMMARY OF GROUNDWATER SAMPLING PARAMETERS

Sample Number	Date Sampled	Time	Source	Analytical Parameters				
				PCB	VOC	Metals	General	Dioxin
1916-GW1	9/1/87	13:30	OW1A-86	X	X	X	X	
1916-GW2	9/1/87	13:45	OW1B-86	X	X	X	X	
1916-GW3	7/1/87	12:20	OW2-86	X	X	X	X	
1916-GW4	7/1/87	14:00	OW3-86	X	X	X	X	
1916-GW5	7/1/87	10:30	OW4A-86	X	X	X	X	
1916-GW6	7/1/87	15:00	OW4B-86	X	X	X	X	X
1916-GW7	7/1/87	15:30	OW5-86	X	X	X	X	
1916-GW8	7/1/87	15:15	Duplicate of GW6	X	X	X	X	X
1916-GW9	7/1/87	12:30	Duplicate of GW3	X	X	X	X	
1916-GW10	7/1/87	14:30	Water Blank	X	X			
1916-GW11	7/1/87	14:20	Bailer Rinse	X	X	X	X	X
1916-GW12	8/1/87	09:30	Terra Prod. Dom.	X	X			
1916-GW13	8/1/87	10:00	Terra Prod. Ind.	X	X			
1916-GW14	8/1/87	10:30	Superior Moving	X	X			

outlined on Table 3.3. The water blank sample was poured from supplied bottled deionized water. The bailer rinse sample was poured from a cleaned bailer prior to use in OW4B-86. Duplicate samples were obtained from OW4B-86 and OW2-86, respectively, using the same bailer as the original water sample.

Water samples for PCB and VOC analysis were also obtained from pumping wells on neighboring properties. These samples were obtained from the closest source to the pump and were allowed to flow to ensure fresh water supply where possible.

3.6 HYDRAULIC MONITORING

During the course of the investigation water level measurements were taken in the observation wells after installation. The results of this monitoring are summarized on Table 3.4. Examination of these data indicates that the observation wells completed in the till have not fully stabilized.

TABLE 3.4

WATER LEVEL DATA
(FT AMSL)

WELL DESIGNATION	REFERENCE ELEVATION (FT AMSL)	DEC. 17	DEC. 18	DEC. 19	DEC. 20	DEC. 21	DEC. 22	DEC. 23	JAN 5/87	JAN 6	JAN 7	JAN 8	JAN 9	JAN 10	JAN 11
OW1A-86	798.08	791.74	788.81	785.02	781.13	781.85	777.38	776.11	762.48	761.86*	NM*	688.31*	689.51*	697.18	704.69
OW1B-86	797.49	787.92	790.21	790.19	790.07	790.03	789.80	789.75	790.68*	790.04*	789.68*	789.58	789.34*	789.27	789.12
OW2-86	798.27	-	-	787.77	787.65	787.59	787.56	787.59	788.29*	787.03*	NM*	NM	786.94	787.27	NM
OW3-86	794.72	-	-	-	-	-	-	778.27	779.56*	NM*	775.14	NM	778.56	780.63	780.66
OW4A-86	792.61	-	-	-	-	-	744.49	744.49	744.52	744.57*	744.53*	NM	744.61	744.65	744.58
OW4G-86	792.27	-	-	-	-	-	-	766.59	770.09*	767.19*	NM*	NM	769.16	769.78	769.82
OW5-86	793.08	-	-	784.89	782.96	781.86	781.14	780.83	778.99*	760.50*	NM*	NM	779.01	779.37	779.21

NOTE: *Indicates well development or sampling in progress

3.7 GEOPHYSICAL SURVEY

A geophysical survey of the site was conducted in conjunction with Phase I construction activities. The objective of this survey was to identify anomalies which may be representative of additional buried disposal areas. A magnetometer survey was conducted over the site from January 8 and 11, 1987. Magnetometer readings were recorded at 20-foot grid intervals as illustrated on Plan 1. Additional readings were made at 10-foot spacings where significant deviations from the natural gradient were noted, and not explainable in terms of visible metallic objects. Background readings were recorded at two stations on adjacent properties. One station is located on the southeast of the Superior Moving and Storage property. The second series of readings were recorded south of State Road 32, in the vicinity of a buried gas line, to demonstrate the sensitivity of the instrument.

The magnetometer used in this survey was a McPhar Proton Magnetometer, Model GP-81. This unit consisted of an omni directional, noise cancelling torroidal coil sensor mounted upon a six-foot aluminum rod, and a pre-calibrated instrument. This type of magnetometer measures the total magnetic field at each station. Aberrations in the magnetic field can be identified by contouring data points in plan view, or plotting results for

each survey line. Sensitivity of the instrument is in the range of one gamma. Duplicate readings at each station agree well unless strong magnetic gradients are present. These gradients can be created by fences, vehicles or buried metallic objects.

The raw data obtained from the geophysical survey is included in Appendix D. These data were plotted and contoured to identify areas of significant magnetic potential. The resultant contour plot is presented on Plan 1. Steep magnetic gradients were recognized in the vicinity of storage drums, trailers, tankers, construction equipment, scrap metal, fences, waste containers, and an abandoned car. These items are all identified on Plan 1. Only one area of unexplained anomalous readings is identified on Plan 1 and is delineated as anomaly A. This area occurs adjacent to the original haul road. There was no obvious metallic expression recognized at surface. Generally, the north half of the site displays little magnetic expression ($\pm$ 50 gammas). An average value is on the order of 56,140 gammas. The southern half of the site appears to exhibit a lower average value, but many natural trends were obscured by the presence of construction equipment.

The results of this survey do not identify any significant areas of waste disposal which will require

future attention. It is recommended that the vicinity of anomaly A be visually inspected for surface metallic expression.

4.0 SITE SETTING

4.1 PHYSIOGRAPHY

The former P.R. Mallory Plant Site is situated upon a flat glacial till plain with minimal topographic expression. The most significant physiographic feature in the area is the ravine created by the creek which transects the northeast corner of the site and discharges into Little Sugar Creek north of the site. The ravine is V-shaped, with very steep slopes and a slightly meandering course. The width of the ravine is on the order of 100 feet and the depth varies from 25 to 40 feet.

4.2 GEOLOGY

The geology observed underlying the site is generally consistent with the description of regional geology presented in Section 2.2. Two distinct stratigraphic units are recognized at the site. Continuous sampling has permitted detailed characterization of these units. The two units identified include a thick sequence of glacial till, underlain by glacially derived sands and gravels. The glacial till unit has been subdivided into an upper weathered zone, massive till, and discontinuous sandy horizons. A geological cross-section (Figure 4.1) has been constructed

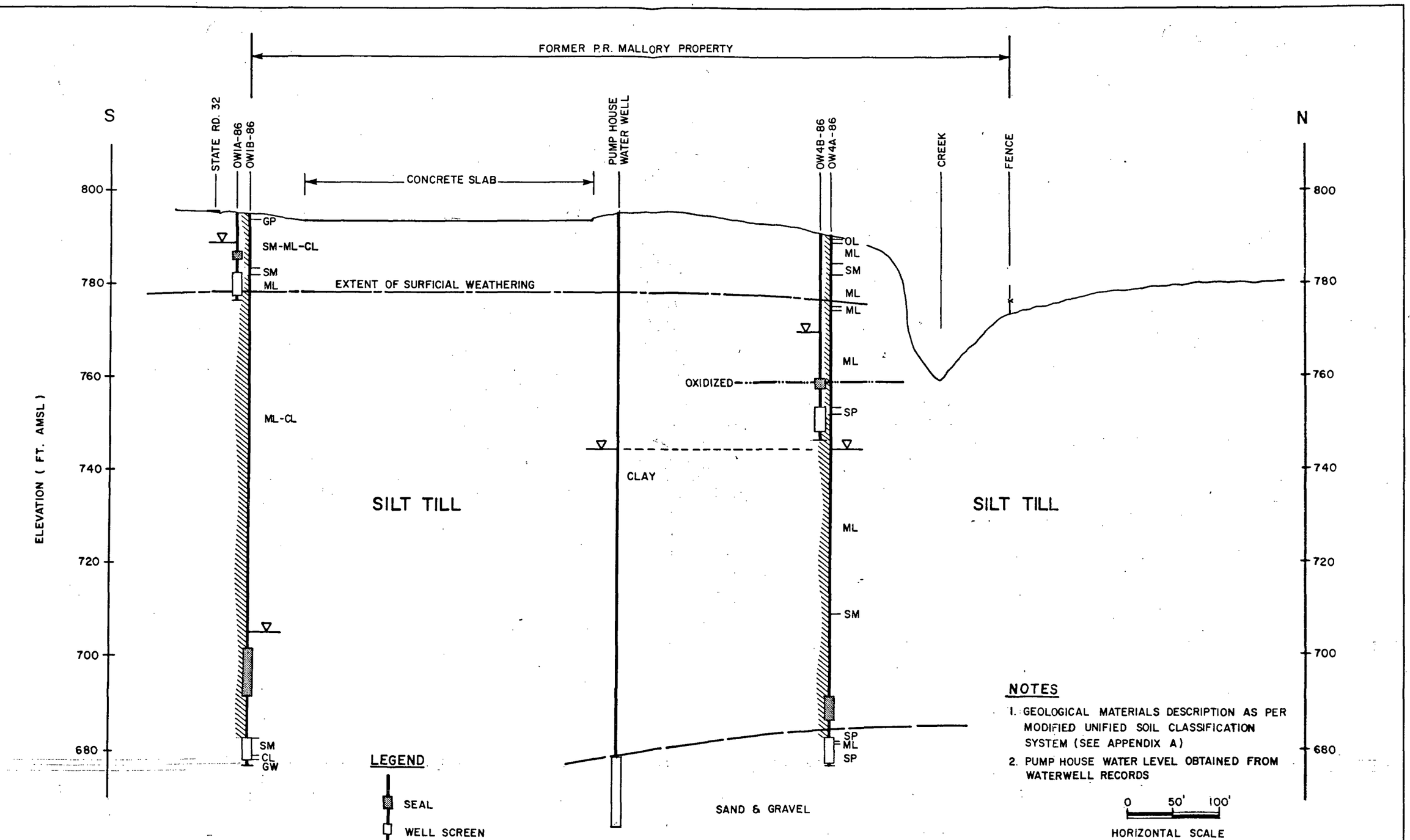


figure 4.1

GEOLOGIC CROSS-SECTION
FORMER P.R. MALLORY PLANT SITE
Crawfordsville, Indiana

CRA

1916-31/03/87

through well nests OW1-86 and OW4-86 and the on-site water well to demonstrate the stratigraphic relationships.

4.2.1 Till Unit

The former P.R. Mallory Plant Site is continuously underlain by glacial till which varies in thickness from 105 to 113 feet. In general, this till unit is a uniform, gray silt till with textural variations from little to some sand, trace to some clay and trace to little gravel. The till is usually very slightly moist, slightly cohesive and hard to very hard. Minor features occasionally recognized within the till unit include closed hairline fractures with random orientations, limited lateral extent, and occasional silt or sand coatings; silty partings partially enhanced by the drilling methods; and a zone of alteration which may represent a contact between two distinct glacial till events. This zone appears at depths between 30 and 35 feet and consists of more intense fracturing and yellow iron staining on fracture surfaces, around pebbles and occasionally pervasively through the matrix. The expression of this zone in OW5-86 consisted of black coatings on the fracture surfaces and surrounding pebbles.

The upper 15 to 20 feet of the Till Unit consistently displays effects of weathering and secondary

alteration. The characteristics of this sub-unit are described in Section 4.2.1.1. Several discontinuous granular horizons were identified within the Till Unit and are described in detail in Section 4.2.1.2.

4.2.1.1 Upper Weathered Zone

The upper 15 to 20 feet of the Upper Till Unit consists of soft, highly variable, yellowish brown to gray, sandy to clayey silt till probably created by the effects of weathering processes. In the upper five feet most original textures are obscured and difficult to recognize as glacial till. As depth increases, original textures are distinguishable and the color gradually changes from brown to grayish brown to gray. The texture of this unit is generally sandier. Sand horizons occur within the weathered zone in OW1A-86 and OW2-86. A sand horizon in OW3-86 corresponds with the base of the upper weathered zone.

4.2.1.2 Discontinuous Granular Horizons

The uniformity of the Till Unit is interrupted in several locations by thin discrete lenses of sand or sand and gravel. Most occurrences displayed thicknesses less than one foot, however, a thickness of

2.5 feet was noted in OW2-86 and OW3-86, respectively. Most of these sand horizons appear to be isolated, discontinuous units. In OW4A-86 several sand occurrences were observed to possess high core angles and different orientations. These occurrences are representative of sand filled fractures within the Till Unit. The stratigraphy observed in OW4B-86 was similar to that observed in OW4A-86, however, the observed granular horizons could not be confidently correlated over a lateral distance of six feet.

4.2.2 Sand and Gravel Unit

The base of the Till Unit occurs at a depth between 105 and 113 feet and is underlain by silty fine to medium sand with some gravels. Accurate definition of the upper contact of this unit was hindered by the pressurized sands washing into the annulus of the augers. At OW1A-86, silt till was observed beneath the initial sand bed, and further sampling demonstrated gravelly sands within the auger annulus. Monitoring of this well has provided some concern to the relationship of this completion with the Sand and Gravel Unit. It is possible that OW1A-86 is completed within an isolated granular horizon above the more extensive Sand and Gravel Unit. Further water level monitoring is required to verify this.

At OW4A-86 the Sand and Gravel Unit was intersected at a depth of 105 feet below ground. At this location the unit was well sorted, uniform fine to medium grained sand and was underlain by laminated silt. The remainder of the borehole was advanced without continuous sampling as the split spoon sampler was blocked by coarse gravel.

From the available information, this Sand and Gravel Unit appears to be laterally extensive and deposited by glaciofluvial processes. Minor facies variations of fine-grained sediment and/or till can be expected within this environment.

4.3 HYDROGEOLOGY

The Former P.R. Mallory Plant Site has also been characterized in terms of hydrogeologic properties in order to assess the potential for contaminant migration via groundwater movement. The stratigraphic units described in Section 4.2 have been used as a basis for defining the hydrostratigraphy and outlining the groundwater flow system. These hydrostratigraphic units are characterized by hydraulic conductivity estimation determined by grain size distribution analysis and response tests. The results of these tests are summarized in Tables 4.1 and 4.2 respectively.

TABLE 4.1

SUMMARY OF GRAIN SIZE DISTRIBUTION ANALYSIS

Hole Number	Sample Number	Depth (ft)	% Sand			% Silt	% Clay (<.002 mm)	d_{10} (mm)	K (estimated)	Moisture Content (%)	Comment
			Coarse	Medium	Fine						
OW1A-86	3A CS	8.5 - 9.5	6	11	34	36	13	9×10^{-4}	8.1×10^{-7}	14.4	SILTY SAND, little clay (WEATHERED TILL?)
OW1A-86	9 CS	38 - 43	6	10	23	43	18	5.7×10^{-4}	3.2×10^{-7}	9.0	SANDY SILT, little clay (TILL)
OW1A-86	24 CS	108 - 113	1	10	28	40	21	1.2×10^{-4}	1.4×10^{-8}	14.2	SANDY SILT, some clay (TILL)
OW1A-86	25 CS	113 - 116.5	1	13	70	10	6	2.7×10^{-2}	7.3×10^{-4}	16.6	SAND, little silt
OW2-86	2A CS	3.5 - 5.5	-	-	2.5	57.5	40	5×10^{-6}	2.5×10^{-1}	28.4	CLAYEY SILT, trace sand (WEATHERED TILL)
OW2-86	8B CS	32.3 - 33	5	10	49	19	17	1.3×10^{-4}	1.7×10^{-8}	13.1	FINE SAND, little silt, clay

TABLE 4.2

SUMMARY OF RESPONSE TESTS

Designation	Date	Duration (min)	To (sec)	K (cm/sec)	Hydrogeologic Unit
OW1A-86	8/1/87	168.5	122,400	4.4×10^{-7}	Sand lense above sand and gravel aquifer
OW1B-86	7/1/87	113	2,850	1.9×10^{-5}	Sand lense within till zone
OW2-86	5/1/87	75	1,152	4.7×10^{-5}	Isolated sand lense within till aquitard
OW3-86	7/1/87	168.5	11,820	4.5×10^{-6}	Isolated sand lense within till aquitard
OW4A-86	6/1/87	-	<5	$<1 \times 10^{-2}$	Sand and gravel aquifer
OW4B-86	7/1/87	240.5	24,900	2.1×10^{-6}	Isolated sand lense
OW5-86	7/1/87	277	22,200	2.4×10^{-6}	Till aquitard (fractured)

Well Diameter (2r) = 5.08 cm
Borehole Diameter (2R) = 23.5 cm
Screen Length (L) = 154 cm

$$\text{Hydraulic Conductivity} = K = \frac{r^2 \ln \frac{L}{R}}{2 L T_o} = \frac{0.0539 \text{ cm}}{T_o \text{ sec}}$$

Note:

Hydraulic conductivity for OW4A-86 based upon observations during development.

The hydrostratigraphy is characterized by two main units, the Till Aquitard and a Sand and Gravel Aquifer. The Till Aquitard can be further subdivided into a Weathered Till Zone and Isolated Permeble Horizons. The characteristics of these units are outlined in the following sections.

4.3.1 Till Aquitard

The Till Unit described in Section 4.2.1 is the most significant hydrogeologic unit at the site. Generally the fine grained nature of the materials serves as a confining layer to downward groundwater movement. Two samples of this till were submitted for grain size distribution analysis and estimation of hydraulic conductivity. The estimated hydraulic conductivity varied between 1.4×10^{-8} and 3.2×10^{-7} cm/sec.

Observation well OW5-86 was screened within the Till Aquitard. No major permeable horizons were recognized within the monitoring interval. Water level recovery at this location has allowed the hydraulic conductivity to be estimated as 2.4×10^{-6} cm/sec. Fracturing and a minor silt seam may be responsible for slightly increased permeability over massive till.

4.3.1.1 Weathered Till Aquitard

The upper 17 feet of the stratigraphic sequence at the site exhibits evidence of alteration due to weathering processes as described in Section 4.2.2.1. Two samples from this zone were submitted for grain size distribution analysis. The first sample from OW1A-86 was silty sand with little clay, and posessed a moderately high moisture content. The estimated hydraulic conductivity is 8.1×10^{-7} cm/sec. OW1B-86 was screened below this interval and exhibited a hydraulic conductivity of 1.9×10^{-5} cm/sec. A granular horizon was present within the monitoring interval.

4.3.1.2 Isolated Permeable Horizons

Several granular horizons were identified at depths less than 50 feet. These granular horizons either consisted of discrete sedimentary beds or sand filled fractures as described in Section 4.2.1.2. In either case the lateral continuity of these horizons is suspected to be limited. A sample of the granular material from the monitoring interval of OW2-86 was submitted for grain size distribution analysis. The resultant curve as presented in Appendix B indicates a significant silt and clay content,

however this may be due to inclusion of till with the submitted sample. The hydraulic conductivity estimated from this analysis is 1.7 x 10^{-8} cm/sec. Monitoring the water level recovery at OW2-86 indicates that a value of 4.7 x 10^{-5} cm/sec is representative of the actual situation.

The remaining shallow wells, OW3-86 and OW4B-86 are also screened within discrete granular horizons. The hydraulic conductivity as determined from well response tests are 4.5 x 10^{-6} and 2.1 x 10^{-6} cm/sec respectively.

4.3.2 Sand and Gravel Aquifer

The Sand and Gravel Unit described in Section 4.2.2 also serves as a regional water supply aquifer as discussed in Section 2.3. As mentioned previously the results obtained from monitoring OW1A-86 are inconsistent with the expected hydrogeological situation. The grain size distribution of the sample submitted from OW1A-86 is predominantly fine sand with little silt. The estimated hydraulic conductivity is 7.3 x 10^{-4} cm/sec. A preliminary value of the in-situ hydraulic conductivity is less than 4 x 10^{-7} cm/sec. based upon water level recovery data.

Samples from the Sand and Gravel Aquifer at OW4A-86 were not submitted for grain size distribution analyses. The hydraulic conductivity has been estimated as being >1 x 10^{-2} cm/sec. based upon the observed recovery following water removal.

4.3.3 Groundwater Flow System

The groundwater flow system at the former P.R. Mallory Plant Site is created by the juxtaposition of the hydrogeologic units described above. Firstly, groundwater infiltrates the system at surface to a water table within the Weathered Till Aquitard. Vertical flow predominates in this unit except where granular horizons increase the potential for horizontal movement.

The bulk of the groundwater flow system is comprised of the Massive Till Aquitard. Groundwater flow within this unit is directed predominantly downwards. The potential for downward flow can be determined from the vertical hydraulic gradient observed between OW4B-86 and OW4A-86. The observed vertical gradient following well development was -0.35 ft/ft. Due to the low hydraulic conductivity, and the observed dryness of the massive till, the bulk of the actual groundwater movement will occur along zones of increased hydraulic conductivity created by the

fracture system or the presence of granular materials. It is difficult to estimate the connectivity of this system from the available information, however the potential for large scale groundwater movement is limited.

Horizontal flow in the till will occur but is generally of less importance. Available hydraulic head data indicates that horizontal flow within this unit is generally in a northeast direction. The actual gradients and flow velocities cannot be determined at this time due to the fact that the water levels likely are not stabilized. Additional water level measurements will be taken prior to the next sampling round.

The Sand and Gravel Aquifer serves as a regional water supply source and hence is characterized by higher hydraulic conductivity, and confined conditions. Groundwater flow within this unit is horizontal. The direction of the horizontal hydraulic gradient can not be determined from the available data, as it was not possible to obtain water levels from the production well on Site.

5.0 GROUNDWATER CHEMISTRY

During the initial hydrogeologic investigation, groundwater samples were collected from seven observation wells, and three domestic water supply wells adjacent to the site. Additional samples were collected to maintain quality control standards outlined in the QAPP. Samples from the observation wells were analyzed for PCB, VOC, as well as selected metal and general chemistry parameters.

One sample from OW4B-86 was submitted for determination of dioxin and furan content. Three samples from the domestic wells were submitted for PCB and VOC determinations. Results of the round-one groundwater sampling will be discussed on a parameter group basis. PCB, VOC, metals and general chemistry analyses were performed by Wadsworth/Alert Laboratories of Canton, Ohio. Dioxin analyses were performed by Hazleton Laboratories of Madison, Wisconsin.

5.1 PCB

Results of the chemical analyses for PCB are summarized in Table 5.1. Negligible amounts of the various Arochlors were reported for most of the groundwater samples

TABLE 5.1

GROUNDWATER GEOCHEMISTRY RESULTS
PCB's (ug/L)

Sample Number -	1916-GW1	1916-GW2	1916-GW3	1916-GW9 Duplicate of	1916-GW4	1916-GW5	1916-GW6	1916-GW8 Duplicate of	1916-GW7
Source -	OW1A-86	OW1B-86	OW2-86	OW2-86	OW3-86	OW4A-86	OW4B-86	OW4B-86	OW5-86
COMPOUND									
PCB 1016	ND (0.5)	ND (0.5)	ND (1)	ND (1)	ND (1)	ND (2)	ND (6)	ND (1)	ND (0.5)
PCB 1221	ND (0.51)	ND (0.5)	ND (0.5)	ND (1)	ND (1)	ND (2)	ND (6)	ND (1)	ND (0.5)
PCB 1232	ND (1)	ND (0.5)	ND (1)	ND (1)	ND (1)	ND (2)	ND (6)	ND (1)	ND (0.5)
PCB 1242	ND (1)	ND (0.5)	ND (1)	ND (1)	ND (1)	ND (2)	ND (6)	ND (1)	ND (0.5)
PCB 1248	ND (2)	ND (0.5)	ND (2)	ND (2)	2.1	2.8	ND (6)	ND (1)	ND (1)
PCB 1254	1.8	ND (1)	1.1	1.7	ND (1)	ND (4)	ND (5)	ND (1)	ND (1)
PCB 1260	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (2)	ND (5)	ND (1)	ND (1)

NOTES:

( ) - indicates method detection limit
ND - indicates not detected at method detection limit

TABLE 5.1

GROUNDWATER GEOCHEMISTRY RESULTS
PCB's (ug/L)

Sample Number -	1916-GW10	1916-GW11	1916-GW12	1916-GW13	1916-GW14
Source -	Water Blank	Bailer Rinse	Terra. Prod. Dom.	Terra. Prod. Ind.	Superior Moving
COMPOUND					
PCB 1016	ND (0.5)	ND (0.5)	ND (1)	ND (0.5)	ND (0.5)
PCB 1221	ND (0.5)	ND (0.5)	ND (1)	ND (0.5)	ND (0.5)
PCB 1232	ND (0.5	ND (0.5)	ND (1)	ND (0.5)	ND (0.5)
PCB 1242	ND (0.5)	ND (0.5)	ND (1)	ND (0.5)	ND (0.5)
PCB 1248	ND (0.5)	ND (0.5)	ND (1)	ND (0.5)	ND (0.5)
PCB 1254	ND (1)	ND (1)	ND (2)	ND (1)	ND (1)
PCB 1260	ND (1)	ND (1)	ND (2)	ND (1)	ND (1)

NOTES:

( ) - indicates method detection limit
ND - indicates not detected at method detection limit

PCB-1234 was detected at concentrations slightly above the method detection limits in samples from OW1A-86 and OW2-86. Similarly PCB-1248 was detected in OW3-86 and OW4A-86. The proximity of these values to the method detection limit and the observed presence of PCB at similar levels in blank samples from the soil survey suggests that these low level results are not truly indicative of PCB presence. The sample from OW4B-86 was not analyzed to the same low levels of other samples, however no PCB's were detected in the duplicate sample collected at the same location.

The contract laboratory (Wadsworth/Alert) used pattern recognition instead of retention time windows to confirm the identification of the individual Arochlors. Considering the complex nature of environment samples such as these, and consequently, the complex nature of the associated chromatograms, it would be exceptionally difficult to confirm any pattern recognition at or near the reported method detection limits, typically reported as 0.5 to 6.0 ug/L for these samples.

The samples collected in the next monitoring round will serve to clarify this issue and confirm these results.

5.2 VOLATILE ORGANIC COMPOUNDS

Results of the chemical analyses for VOC are presented in Table 5.2. No volatile organic compounds were detected in groundwater from round one sampling. These results will be confirmed by future sampling.

5.3 METALS

Groundwater samples from the observation wells were submitted for analyses of selected Hazardous Substance List metals. Reported data for lead, chromium and cadmium are presented in Table 5.3. Chromium was detected at 0.03 mg/L in sample GW9 (a duplicate of OW2-86) but not in the sample of OW2-86. A similar value was reported for GW-11 (bailer rinse). Considering the fact that these values are only slightly above the method detection limit of 0.02 mg/L, the detected concentrations are of little environmental significance.

5.4 GENERAL CHEMISTRY

All groundwater samples from the observation wells were submitted for analysis of selected general chemistry parameters. The purpose of these analyses were to

TABLE 5.2

GROUNDWATER GEOCHEMISTRY RESULTS
VOC (ug/L)

Sample Number - Source -	Method Detection Limit	1916-GW1 OW1A-86	1916-GW2 OW1B-86	1916-GW3 OW2-86	1916-GW9 Duplicate of OW2-86	1916-GW4 OW3-86	1916-GW5 OW4A-86	1916-GW6 OW4B-86	1916-GW8 Duplicate of OW4B-86	1916-GW7 OW5-86
COMPOUND										
chloromethane	(10)	ND	ND	ND	ND	ND	ND	ND	ND	ND
bromomethane	(10)	ND	ND	ND	ND	ND	ND	ND	ND	ND
vinyl chloride	(10)	ND	ND	ND	ND	ND	ND	ND	ND	ND
chloroethane	(10)	ND	ND	ND	ND	ND	ND	ND	ND	ND
methylene chloride	(5)	ND	ND	ND	ND	ND	ND	ND	ND	ND
acetone	(10)	ND	ND	ND	ND	ND	ND	ND	ND	ND
carbon disulfide	(5)	ND	ND	ND	ND	ND	ND	ND	ND	ND
trichlorofluoromethane										
1,1-dichloroethene	(5)	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1-dichloroethane	(5)	ND	ND	ND	ND	ND	ND	ND	ND	ND
trans-1,2-dichloroethene	(5)	ND	ND	ND	ND	ND	ND	ND	ND	ND
chloroform	(5)	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-dichloroethane	(5)	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-butanone	(10)	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1,1-trichloroethane	(5)	ND	ND	ND	ND	ND	ND	ND	ND	ND
carbon tetrachloride	(5)	ND	ND	ND	ND	ND	ND	ND	ND	ND
vinyl acetate	(10)	ND	ND	ND	ND	ND	ND	ND	ND	ND
bromodichloromethane	(5)	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-dichloropropane	(5)	ND	ND	ND	ND	ND	ND	ND	ND	ND
cis-1,3-dichloropropene	(5)	ND	ND	ND	ND	ND	ND	ND	ND	ND
trichloroethene	(5)	ND	ND	ND	ND	ND	ND	ND	ND	ND
dibromochloromethane	(5)	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1,2-trichloroethane	(5)	ND	ND	ND	ND	ND	ND	ND	ND	ND
benzene	(5)	ND	ND	ND	ND	ND	ND	ND	ND	ND
trans-1,3-dichloropropene	(5)	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-chloroethylvinyl ether	(10)	ND	ND	ND	ND	ND	ND	ND	ND	ND
bromoform	(5)	ND	ND	ND	ND	ND	ND	ND	ND	ND

continued....

TABLE 5.2

GROUNDWATER GEOCHEMISTRY RESULTS
VOC (ug/L)

Sample Number - Source -	Method Detection Limit	1916-GW1 OW1A-86	1916-GW2 OW1B-86	1916-GW3 OW2-86	1916-GW9 Duplicate of OW2-86	1916-GW4 OW3-86	1916-GW5 OW4A-86	1916-GW6 OW4B-86	1916-GW8 Duplicate of OW4B-86	1916-GW7 OW5-86
COMPOUND										
2-hexanone	(10)	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-methyl-2-pentanone	(10)	ND	ND	ND	ND	ND	ND	ND	ND	ND
tetrachloroethene	(5)	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1,2,2-tetrachloroethane	(5)	ND	ND	ND	ND	ND	ND	ND	ND	ND
toluene	(5)	ND	ND	ND	ND	ND	ND	ND	ND	ND
chlorobenzene	(5)	ND	ND	ND	ND	ND	ND	ND	ND	ND
ethylbenzene	(5)	ND	ND	ND	ND	ND	ND	ND	ND	ND
styrene	(5)	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total xylenes	(5)	ND	ND	ND	ND	ND	ND	ND	ND	ND

NOTE:

ND - Not Detected

TABLE 5.2

GROUNDWATER GEOCHEMISTRY RESULTS
VOC (ug/L)

Sample Number - Source -	Method Detection Limit	1916-GW10 Water Blank	1916-GW11 Bailer Rinse	1916-GW12 Terra. Prod. Dom.	1916-GW13 Terra. Prod. Ind.	1916-GW14 Superior Moving
COMPOUND						
chloromethane	(10)	ND	ND	ND	ND	ND
bromomethane	(10)	ND	ND	ND	ND	ND
vinyl chloride	(10)	ND	ND	ND	ND	ND
chloroethane	(10)	ND	ND	ND	ND	ND
methylene chloride	(5)	3	ND	ND	ND	ND
acetone	(10)	14	ND	ND	ND	24
carbon disulfide	(5)	ND	ND	ND	ND	ND
trichlorofluoromethane						
1,1-dichloroethene	5)	ND	ND	ND	ND	ND
1,1-dichloroethane	(5)	ND	ND	ND	ND	ND
trans-1,2-dichloroethene	(5)	ND	ND	ND	ND	ND
chloroform	(5)	ND	ND	ND	ND	ND
1,2-dichloroethane	(5)	ND	ND	ND	ND	ND
2-butanone	(10)	ND	ND	ND	ND	ND
1,1,1-trichloroethane	(5)	ND	ND	ND	ND	ND
carbon tetrachloride	(5)	ND	ND	ND	ND	ND
vinyl acetate	(10)	ND	ND	ND	ND	ND
bromodichloromethane	(5)	ND	ND	ND	ND	ND
1,2-dichloropropane	(5)	ND	ND	ND	ND	ND
cis-1,3-dichloropropene	(5)	ND	ND	ND	ND	ND
trichloroethene	(5)	ND	ND	ND	ND	ND
dibromochloromethane	(5)	ND	ND	ND	ND	ND
1,1,2-trichloroethane	(5)	ND	ND	ND	ND	ND
benzene	(5)	ND	ND	ND	ND	ND
trans-1,3-dichloropropene	(5)	ND	ND	ND	ND	ND
2-chloroethylvinyl ether	(10)	ND	ND	ND	ND	ND
bromoform	(5)	ND	ND	ND	ND	ND

continued...

TABLE 5.2

GROUNDWATER GEOCHEMISTRY RESULTS
VOC (ug/L)

Sample Number - Source -	Method Detection Limit	1916-GW10 Water Blank	1916-GW11 Bailer Rinse	1916-GW12 Terra. Prod. Dom.	1916-GW13 Terra. Prod. Ind.	1916-GW14 Superior Moving
COMPOUND						
2-hexanone	(10)	ND	ND	ND	ND	ND
4-methyl-2-pentanone	(10)	ND	ND	ND	ND	ND
tetrachloroethene	(5)	ND	ND	ND	ND	ND
1,1,2,2-tetrachloroethane	(5)	ND	ND	ND	ND	ND
toluene	(5)	ND	ND	ND	ND	ND
chlorobenzene	(5)	ND	ND	ND	ND	ND
ethylbenzene	(5)	ND	ND	ND	ND	ND
styrene	(5)	ND	ND	ND	ND	ND
Total xylenes	(5)	ND	ND	ND	ND	ND

NOTE:

ND - Not Detected

TABLE 5.3

GROUNDWATER GEOCHEMISTRY RESULTS
METALS (mg/L)

Sample Number -	1916-GW1	1916-GW2	1916-GW3	1916-GW9	1916-GW4	1916-GW5	1916-GW6	1916-GW8	1916-GW7
Source -	OW1A-86	OW1B-86	OW2-86	Duplicate of OW2-86	OW3-86	OW4A-86	OW4B-86	Duplicate of OW4B-86	OW5-86
COMPOUND									
Lead	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cadmium	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chromium	ND	ND	ND	0.03	ND	ND	ND	ND	ND

NOTES:

ND - Not Detected
Detection Limites - Lead 0.05 mg/L
Cadmium 0.01 mg/L
Chromium 0.02 mg/L

NS - Not Sampled

TABLE 5.3

GROUNDWATER GEOCHEMISTRY RESULTS
METALS (mg/L)

Sample Number -	1916-GW10	1916-GW11	1916-GW12	1916-GW13	1916-GW14
Source -	Water Blank	Bailer Rinse	Terra. Prod. Dom.	Terra. Prod. Ind.	Superior Moving
COMPOUND					
Lead	NS	ND	NS	NS	NS
Cadmium	NS	ND	NS	NS	NS
Chromium	NS	0.03	NS	NS	NS

NOTES:

ND - Not Detected
Detection Limites - Lead 0.05 mg/L
Cadmium 0.01 mg/L
Chromium 0.02 mg/L

NS - Not Sampled

determine any similarities between the chemistry of the water collected from the various wells and identify potential hydrogeochemical facies which may clarify the hyrogeological situation. The analyzed parameters included alkalinity, total dissolved solids, hardness, sodium, magnesium, potassium, sulphate, chloride, carbonate, and bicarbonate. Calcium concentrations were determined using the relationships between hardness, calcium and magnesium concentrations. These results are presented on Table 5.4.

The major cation and anion concentrations were converted to equivalents per million (epm). The percentage of epm for each ion was plotted on the Piper Trilinear diagram shown on Figure 5.1. Examination of this figure indicates that both the Till Unit and Sand and Gravel Unit waters are basically calcium-bicarbonate type waters. The Sand and Gravel Unit waters though, are characterized by a higher percentage of sodium and potassium.

5.5 DIOXIN

One groundwater sample and two QA/QC samples were submitted for dioxin/furan determinations. Results of these analyses are presented on Table 5.5. No significant concentrations of these parameters were identified in these samples. These results will be confirmed by future sampling.

TABLE 5.4

GROUNDWATER GEOCHEMISTRY RESULTS
GENERAL CHEMISTRY (mg/L)

Sample Number -	1916-GW1	1916-GW2	1916-GW3	1916-GW9	1916-GW4	1916-GW5	1916-GW6	1916-GW8	1916-GW7
Source -	OW1A-86	OW1B-86	OW2-86	Duplicate of OW2-86	OW3-86	OW4A-86	OW4B-86	Duplicate of OW4B-86	OW5-86
COMPOUND									
Alkalinity	360	340	330	390	360	260	420	410	420
Total Dissolved Solids	500	600	14,000	500	800	460	425	430	430
Hardness	350	470	380	510	500	190	420	400	390
Calcium	104	149	94.5	138	162	116	110.5	106	120
Sodium	25	22	13	13	10	36	10	11	14
Magnesium	22	24	35	40	23	18	35	33	22
Potassium	7.5	1.7	5.8	5.4	4.1	47	3.4	3.4	4.1
Sulphate	39	110	65	73	15	59	21	20	12
Chloride	24	46	86	86	10	29	2	2	3
Carbonate	8.5	2.6	2.4	3	2.7	61	3	3	3
Bicarbonate	1,800	1,700	1,600	1,910	1,800	1,300	420	2,000	2,000

TABLE 5.4

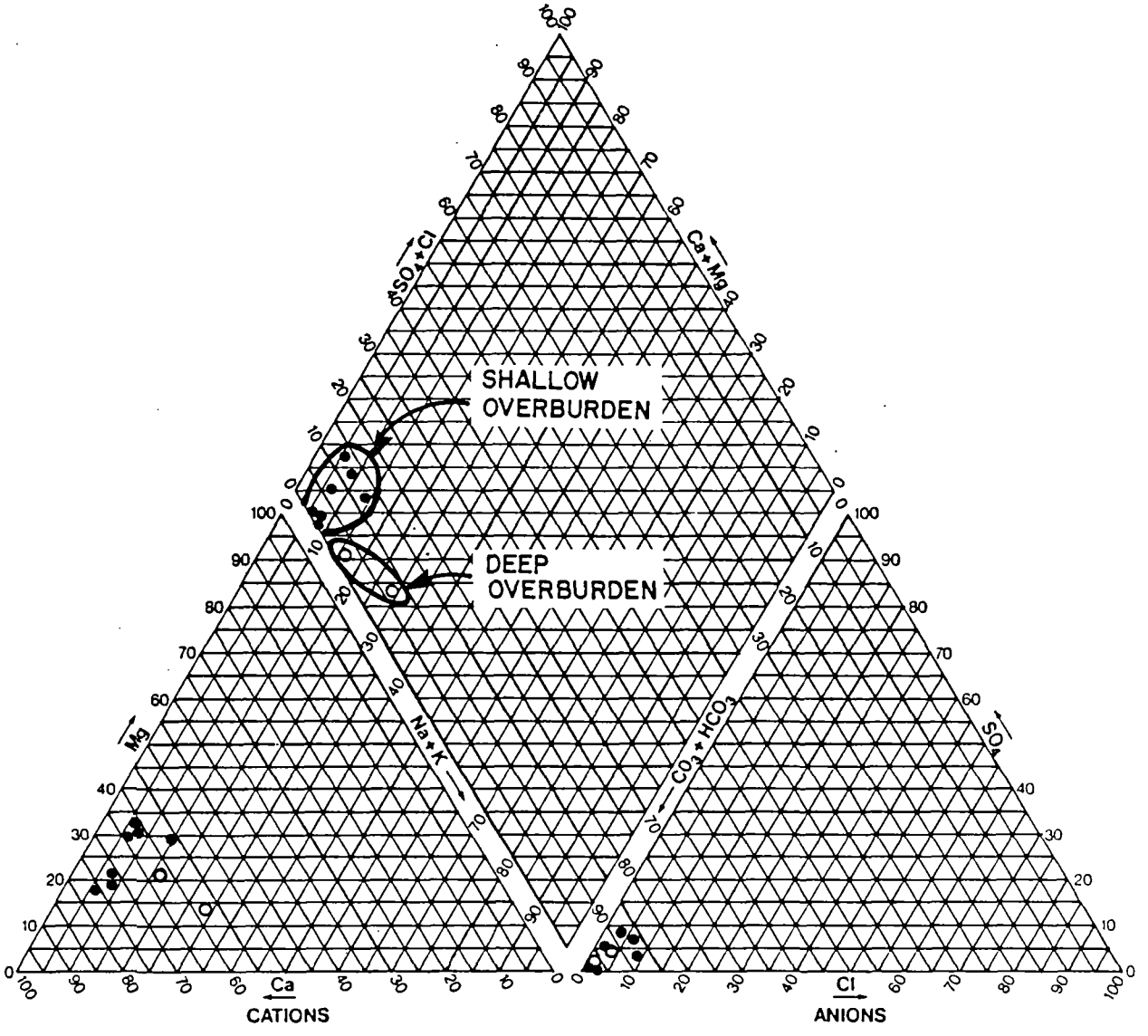
GROUNDWATER GEOCHEMISTRY RESULTS
GENERAL CHEMISTRY (mg/L)

Sample Number -	1916-GW10	1916-GW11	1916-GW12	1916-GW13	1916-GW14
Source -	Water Blank	Bailer Rinse	Terra. Prod. Dom.	Terra. Prod. Ind.	Superior Moving
COMPOUND					
Alkalinity	NS	29	NS	NS	NS
Total Dissolved Solids	NS	1	NS	NS	NS
Hardness	NS	ND	NS	NS	NS
Calcium	NS	NS	NS	NS	NS
Sodium	NS	4.0	NS	NS	NS
Magnesium	NS	0.20	NS	NS	NS
Potassium	NS	0.23	NS	NS	NS
Sulphate	NS	ND	NS	NS	NS
Chloride	NS	ND	NS	NS	NS
Carbonate	NS	ND	NS	NS	NS
Bicarbonate	NS	14	NS	NS	NS

NOTE:

Detection Limit - Hardness 2 mg/L
- Sulphate 5 mg/L
- Chloride 2 mg/L
- Carbonate 0.1 mg/L

NS - Not Sampled
Calcium concentration determined by [Hardness - 4.118 (Magnesium)]/2.497



LEGEND

- ○ DEEP OVERBURDEN SOURCE
- ● SHALLOW OVERBURDEN SOURCE

figure 5.1

GROUNDWATER GEOCHEMICAL FACIES
Crawfordsville, Indiana

CRA

1916-31/03/87

TABLE 5.5

GROUNDWATER GEOCHEMISTRY RESULTS
DIOXINS AND FURANS (ug/L)

Sample Number -	1916-GW6	1916-GW8 Duplicate of	1916-GW11
Source -	OW4B-86	OW4B-86	Bailer Rinse
Compound			
Dioxins			
Tetrachlorodibenzo-p-dioxin	ND (0.2)	ND (0.4)	ND (0.8)
Pentachlorodibenzo-p-dioxin	ND (0.5)	ND (1.0)	ND (0.9)
Hexachlorodibenzo-p-dioxin	ND (0.7)	ND (0.5)	ND (4.4)
Heptachlorodibenzo-p-dioxin	ND (0.8)	ND (1.1)	ND (1.9)
Octachlorodibenzo-p-dioxin	0.6 --	ND (2.0)	ND (1.2)
Furans			
Tetrachlorodibenzofuran	ND (0.2)	ND (0.2)	ND (0.6)
Pentachlorodibenzofuran	ND (0.2)	ND (0.2)	ND (1.0)
Hexachlorodibenzofuran	ND (0.2)	ND (0.2)	ND (1.3)
Heptachlorodibenzofuran	ND (0.5)	ND (1.3)	ND (1.0)
Octachlorodibenzofuran	ND (0.7)	ND (1.2)	ND (0.9)

NOTE:

(0.5) indicates method detection limit

6.0 SUMMARY

The primary objective of the hydrogeologic investigation was to determine the extent and degree of groundwater contamination, if any, at the Site and the potential for off-site migration. This report is intended to present the results of the investigation to date and is not a final Site assessment. However, it is felt that a summary of the findings in the perspective of the main objectives is warranted at this time. The main findings of this study are:

a) The Site is underlain by a glacial till unit approximately 100 feet thick. This unit is primarily massive, but does contain minor units of sand, and sand and gravel. These more permeable units were found to be lense shaped, and are not laterally or vertically extensive. The hydraulic conductivity of the massive till is in the order of 1×10^{-7} cm/sec.

b) Beneath the Till Unit a Sand and Gravel Unit is located. This unit is the major water supply aquifer in the vicinity of the Site. The hydraulic conductivity of this unit is on the order of 1×10^{-2} cm/sec.

c) Hydraulic Head Measurements indicate that a downward gradient exists at the Site. However, due to the low hydraulic conductivity of the Till, the groundwater flow through this unit is small. The low hydraulic conductivity combined with the thickness of till minimize the potential for contaminant migration to the underlying aquifer.

d) Analytical results indicate that groundwater contamination due to past Site activities has not occurred. Further analyses are required to confirm this finding.

Based upon the above, additional hydrogeological investigations, other than groundwater sampling, are not envisioned at this time.

All of Which is Respectfully Submitted

CONESTOGA-ROVERS & ASSOCIATES

Michael G. Mateyk, B.Sc.

Richard G. Shepherd, P. Eng.

REFERENCES

1) Cable, L. W. and Robison, T. M., 1974, Groundwater Resources of Montgomery County, Indiana, State of Indiana, Department of Natural Resources, Bulletin No. 36 of the Division of Water, 20 p.

2) Freeze, R.A., and Cherry, J.A., Groundwater, Prentice-Hall, Inc., Englewood Cliffs, N.J., 604 pl.

3) Gray, H. H., 1982, Map of Indiana Showing Topography of the Bedrock Surface, State of Indiana, Department of Natural Resources, Geological Survey, Miscellaneous Map 36.

4) Gray H. H., 1983, Map of Indiana Showing Thickness of Unconsolidated Deposits, State of Indiana Department of Natural Resources, Geological Survey, Miscellaneous Map 38.

5) Gray, H. H., Droste, J. B., Palton, J. B., Rexroad, C. B. and Shaver, R. H., 1985, Correlation Chart Showing Paleozoic Stratigraphic Units of Indiana, State of Indiana, Department of Natural Resources, Geological Survey

6) Hvorslev, M.J., 1951, Time Lag and Soil Permeability in Groundwater Observations, U.S. Army Corps. of Engineers, Waterways Exp. Sta. Bull, 36, Vicksburg, Miss.

7) Wayne, W. J., 1965, The Crawfordsville and Knightstown Moraines in Indiana, Indiana Department of Conservation, Geological Survey Report of Progress 28, 15 p.

8) Wayne, W. J., Johnson, G. H., and Keller, S. J., 1966, Geologic Map of the 1° x 2° Danville Quadraugle, Indiana and Illinois, Showing Bedrock and Unconsolidated Deposits, State of Indiana, Department of Natural Resources, Geological Survey, Regional Geologic Map No. 2, Danville Sheet, Parts A and B.

APPENDIX A

BOREHOLE STRATIGRAPHIC LOGS

SOIL CLASSIFICATION SYSTEM (MODIFIED U.S.C.)

MAJOR DIVISION			GROUP SYMBOL	TYPICAL DESCRIPTION
HIGHLY ORGANIC SOILS			Pt	PEAT AND OTHER HIGHLY ORGANIC SOILS
COARSE-GRAINED SOILS (MORE THAN HALF BY WEIGHT LARGER THAN NO. 200 SIEVE SIZE)	GRAVELS MORE THAN HALF COARSE FRACTION LARGER THAN NO. 4 SIEVE SIZE	CLEAN GRAVELS	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, < 5% FINES
			GP	POORLY-GRADED GRAVELS, AND GRAVEL-SAND MIXTURES, < 5% FINES
		DIRTY GRAVELS	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES > 12% FINES
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES > 12% FINES
	SANDS MORE THAN HALF COARSE FRACTION SMALLER THAN NO. 4 SIEVE SIZE	CLEAN SANDS	SW	WELL-GRADED SANDS, GRAVELLY SANDS, < 5% FINES
			SP	POORLY-GRADED SANDS, OR GRAVELLY SANDS, < 5% FINES
		DIRTY SANDS	SM	SILTY SANDS, SAND-SILT MIXTURES > 12% FINES
			SC	CLAYEY SANDS, SAND-CLAY MIXTURES > 12% FINES
FINE-GRAINED SOILS (MORE THAN HALF BY WEIGHT PASSES NO. 200 SIEVE SIZE)	SILTS BELOW "A" LINE ON PLASTICITY CHART; NEGLIGIBLE ORGANIC CONTENT		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY SANDS OF SLIGHT PLASTICITY
			MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS, FINE SANDY OR SILTY SOILS
	CLAYS ABOVE "A" LINE ON PLASTICITY CHART; NEGLIGIBLE ORGANIC CONTENT		CL	INORGANIC CLAYS OF LOW PLASTICITY, GRAVELLY, SANDY, OR SILTY CLAYS, LEAN CLAYS
			CI	INORGANIC CLAYS OF MEDIUM PLASTICITY SILTY CLAYS
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
	ORGANIC SILTS & ORGANIC CLAYS BELOW "A" LINE ON PLASTICITY CHART		OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
			OH	ORGANIC CLAYS OF HIGH PLASTICITY

CONVENTIONAL SOIL DESCRIPTIONS

Cohesive (clays etc.)		Non-Cohesive (granular)	
Consistency	'N' Blows/ft.	'N' Blows/ft.	Rel Density
Very soft	0 - 2	0 - 3	Very loose
Soft	2 - 4	4 - 9	Loose
Firm	4 - 8	10 - 29	Medium Dense
Stiff	8 - 15	30 - 49	Dense
Very Stiff	15 - 30	50 - 80	Very Dense
Hard	30	80	Extremely Dense

GRAIN SIZE CLASSIFICATION

COBBLEY	ABOVE 3 In.
GRAVEL	3 In. TO No. 4 (4.76 mm)
COARSE GRAVEL	3 In. TO 3/4 In.
FINE GRAVEL	3/4 In. TO No. 4 (4.76 mm)
SAND	No. 4 (4.76 mm) TO No. 200 (0.074 mm)
COARSE SAND	No. 4 (4.76 mm) TO No. 10 (2.0 mm)
MEDIUM SAND	No. 10 (2.0 mm) TO No. 40 (0.42 mm)
FINE SAND	No. 40 (0.42 mm) TO No. 200 (0.074 mm)
SILT	No. 200 (0.074 mm) TO 0.002 mm
CLAY	LESS THAN 0.002 mm

The following adjectives may be employed to define percentage ranges by weight of minor component:

and	50 - 36%
some	35 - 21%
little	20 - 11%
trace	10 - 1%

STRATIGRAPHIC AND INSTRUMENTATION LOG

(OVERBURDEN)

PROJECT NAME: FORMER P.R. MALLORY PLANT SITE
HOLE DESIGNATION: OW1A-86

PROJECT NO.: 1916
DATE COMPLETED: DECEMBER 15, 1986

CLIENT: DART & KRAFT
DRILLING METHOD: H.S.A. CONTINUOUS

LOCATION: SOUTHWEST CORNER
CRA SUPERVISOR: L. LEMON

DEPTH ft BG	STRATIGRAPHY DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
		798.08	locking cap			
0		794.7	protective casing			
	GP-GRAVEL (FILL): some silt and sand, gray, red brick fragments			1ACS		
	SM-ML-CL - SANDY SILT (TILL) variable composition, trace to some clay, soft gray to yellow brown, weathered, moist			1BCS		
				1CCS		
5			2"Ø Stainless Steel pipe	2ACS		
				2BCS		
				2CCS		
	SM-SILTY SAND: gray-brown, dilatent, wet			2DCS		
				2ECS		
10	ML-SILT (TILL): some sand to sandy trace to little clay, trace gravel, uniform brown to light gray, mottled, dilatent, very moist to wet			3ACS		
				3BCS		
				3CCS		
				3DCS		
15				3ECS		
				4CS		
		777.7				
20	ML-CL -SILT (TILL): little to some clay, little to some sand, trace to little gravel, occasional cobble, boulder, gray, hard to very hard, uniform, friable to slightly cohesive, slightly moist to dry			5SS		40
25				6SS		77
30			cement/ bentonite grout	7SS		142
35				8CS		
40				9CS		
	-3 inches: silty very fine sand, gray, dilatent					
45				10CS		
	-6 inches: sand, little silt, gravel, gray, slightly wet					
50				11CS		
	-thin sand seam					
55				12CS		
60						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

(oval) GRAIN SIZE ANALYSIS WATER FOUND STATIC WATER LEVEL

STRATIGRAPHIC AND INSTRUMENTATION LOG

(OVERBURDEN)

PROJECT NAME: FORMER P.R. MALLORY PLANT SITE
HOLE DESIGNATION: OW1A-86

PROJECT NO.: 1916
DATE COMPLETED: DECEMBER 15, 1986

CLIENT: DART & KRAFT
DRILLING METHOD: H.S.A. CONTINUOUS

LOCATION: SOUTHWEST CORNER
CRA SUPERVISOR: L. LEMON

DEPTH ft BG	STRATIGRAPHY DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
60						
	ML-CL - SILT (TILL): see page 1			13CS		
65				14CS		
			cement/ bentonite grout			
70				15CS		
75				16CS		
80				17CS		
85				18CS		
				19CS		
90				20CS		
95				21CS		
			bentonite slurry			
100				22CS		
105				23CS		
			sand pack and natural			
110	-5 inch sand pocket, green, compact moist			24CS		
		681.7	no. 10 slot screen			
115	SM-FINE SAND: little silt, gray, dense, well sorted, dilatent, uniform, saturated		Screen Details:	25CS		
	CL-CLAYEY SILT (TILL): hard, gray		Set screen to 117' (Elev. 677.7)	26SS		
	GW-SAND AND GRAVEL: gray, wet	676.7	Length - 5' Diameter - 2" Stainless Steel continuous	27SS		
120	END OF HOLE AT 118 FT. B.G.S.					

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS WATER FOUND STATIC WATER LEVEL

STRATIGRAPHIC AND INSTRUMENTATION LOG

(OVERBURDEN)

PROJECT NAME:	FORMER P.R. MALLORY PLANT SITE	HOLE DESIGNATION:	OW1B-86
PROJECT NO.:	1916	DATE COMPLETED:	DECEMBER 16, 1986
CLIENT:	DART & KRAFT	DRILLING METHOD:	H.S.A. CONTINUOUS
LOCATION:	SOUTHWEST CORNER	CRA SUPERVISOR:	L. LEMON

DEPTH ft BG	STRATIGRAPHY DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
0		797.49 794.9	locking cap protective casing			
5	FOR STRATIGRAPHIC DETAIL REFER TO STRATIGRAPHY AND INSTRUMENTATION LOG (OVERBURDEN) FOR OW1A-86		2"Ø Stainless Steel pipe cement/ bentonite grout			
10			bentonite pellet seal			
15	ML-SILT (TILL): some sand, little clay, trace gravel, uniform, brownish gray, firm, very moist		sand pack no. 10 slot screen	1SS	☒	16
20	END OF HOLE AT 19 FT. BGS	775.9	Screen Details: Set screen to 18' (Elev. 776.9) Length - 5' Diameter - 2" Stainless Steel continuous			
25						
30						
35						
40						
45						
50						
55						
60						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS WATER FOUND STATIC WATER LEVEL

STRATIGRAPHIC AND INSTRUMENTATION LOG

(OVERBURDEN)

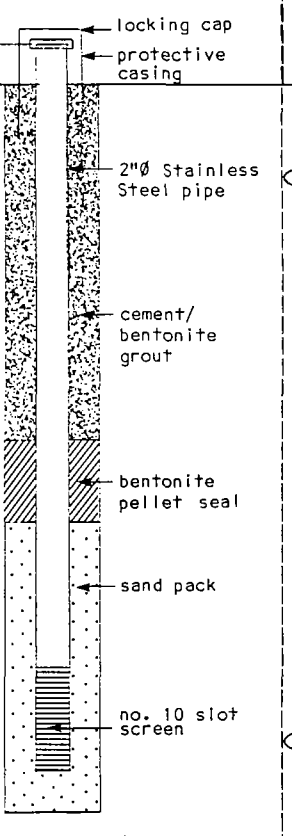
PROJECT NAME: FORMER P.R. MALLORY PLANT SITE
HOLE DESIGNATION: OW2-86

PROJECT NO.: 1916
DATE COMPLETED: DECEMBER 17, 1986

CLIENT: DART & KRAFT
DRILLING METHOD: H.S.A. CONTINUOUS

LOCATION: SOUTHEAST CORNER
CRA SUPERVISOR: L. LEMON

DEPTH ft BG	STRATIGRAPHY DESCRIPTION & REMARKS	ELEVATION ft AMSL
		798.27
0		796.0
	OL-GP-TOPSOIL AND GRAVEL (FILL)	
	CL-CLAYEY SILT (TILL): some sand, irregular texture, brown, gray, weathered moist	
5		
	SC-CL-SANDY CLAYEY SILT (TILL): brown soft, very moist	
	CL-CLAY (TILL?): some silt, little sand, trace gravel, brown-gray mottled, very high plasticity, sticky, very moist	
10		
	SW-SP-SAND AND GRAVEL: brown, wet	784.2
15	SM-ML-SANDY SILT (TILL): little clay, brown, gradually becomes gray	781.5
	-at 17 FT: dark gray silt till and gray silt laminae	778
20	SP-SAND: little gravel, brown, loose, wet	
	ML-SILT (TILL): little to some sand, trace to little clay, gray brown to gray	
25		
30	SP-GP-COARSE SAND AND GRAVEL: wet	766.5
	ML-SILT (TILL): as above	
	SM-FINE SAND: little silt, saturated	763.7
	ML-SILT (TILL): as above	
35		761
	AUGER REFUSAL AT 35.0 FT. BGS	
	NOTE: 1. Auger refusal due to boulder	
40		
45		
50		
55		
60		



Screen Details:

Set screen to 33'
(Elev. 763)
Length - 5'
Diameter - 2"
Stainless Steel
continuous

SAMPLE NUMBER	STATE	'N' VALUE
1ACS		
1BCS		
2ACS		
2BCS		
3CS		
4ACS		
4BCS		
5CS		
6ACS		
6BCS		
7CS		
8ACS		
8BCS		
9ACS		
9BCS		

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

(oval) GRAIN SIZE ANALYSIS WATER FOUND STATIC WATER LEVEL

STRATIGRAPHIC AND INSTRUMENTATION LOG

(OVERBURDEN)

PROJECT NAME: FORMER P.R. MALLORY PLANT SITE
HOLE DESIGNATION: OW3-86

PROJECT NO.: 1916
DATE COMPLETED: DECEMBER 22, 1986

CLIENT: DART & KRAFT
DRILLING METHOD: H.S.A. CONTINUOUS

LOCATION: AT CORNER OF FENCE
CRA SUPERVISOR: L. LEMON

DEPTH ft BG	STRATIGRAPHY DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
0		794.72	locking cap; protective casing			
		792.7				
	OL-GP-TOPSOIL AND GRAVELLY FILL					
	ML-SILT (TILL?): trace to little clay, firm, blocky, rootlets, iron alteration, nuggets, moist			1CS		
5	ML-SILT (TILL): little sand to sandy, high plastic, soft, sticky, weathered orange brown, gravel increases, very moist		2"Ø Stainless Steel pipe	2CS		
10	-some gray unaltered patches visible		cement/ bentonite grout			
	SM-ML-SANDY SILT (TILL): little gravel, light brown, moist			3CS		
15	ML-SILT (TILL): little sand, trace clay, very stiff, gray-brown, moist			4CS		
	SP-SAND: coarse, trace gravel, wet	774.7				
20	ML-CL-SILT (TILL): little sand, gravel, trace to little clay, occasional cobble, silt parting, gray, moist to dry			5CS		
25			bentonite pellet seal	6CS		
30		762.9	sand pack			
	SM-FINE SAND: trace silt, dense, very moist			7CS		
	ML-CL-SILT (TILL): as above		screen			
35	-iron staining in matrix and along partings and fractures between 34.5 and 36 FT., dry			8CS		
40			bentonite pellet seal			
				9CS		
45			sand			
				10CS		
	END OF HOLE AT 47.2 FT. BGS	745.5				
50			Screen Details:			
			Set screen to 35.5' (Elev. 757.2)			
			Length - 5'			
			Diameter - 2"			
55			Stainless Steel continuous			
60						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS WATER FOUND STATIC WATER LEVEL

STRATIGRAPHIC AND INSTRUMENTATION LOG

(OVERBURDEN)

PROJECT NAME: FORMER P.R. MALLORY PLANT SITE
HOLE DESIGNATION: OW4A-86

PROJECT NO.: 1916
DATE COMPLETED: DECEMBER 21, 1986

CLIENT: DART & KRAFT
DRILLING METHOD: H.S.A. CONTINUOUS

LOCATION: NORTHWEST OF EXCAVATION
CRA SUPERVISOR: L. LEMON

DEPTH ft BG	STRATIGRAPHY DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
0		792.61	locking cap; protective casing			
	OL-SILT: topsoil, some clay, dark brown	789.9		1CS		
	ML-SILT (TILL): some sand to sandy, little to some clay, trace gravel, massive, soft, light brown, mottled, very moist		2"Ø Stainless Steel pipe	2CS		
	SM-SANDY SILT (TILL): trace clay, gravel, brown-gray, mottled, some alteration, occasional gravelly zone.					
	ML-SILT (TILL): some sand to sandy, trace clay, brown to gray brown, firm, plastic, moist			3CS		
	-becomes gray at 13.9 FT.					
	ML-SILT (TILL): trace clay, sand, very dense, uniform, dilatent, very moist	774.9		4CS		
	ML-SILT (TILL): little to some sand, trace to little clay, gravel, uniform, hard to very hard, cohesive to friable, slightly moist to dry		cement/ bentonite grout	5CS		
	-2 inch: SAND SEAM (SW), moist			6CS		
	-thin sand seams, very slightly moist, notable iron staining in matrix and along thin fracture planes			7CS		
	-several thin fractures at high core angles			8CS		
	SP-SAND: medium to fine, moist to wet	753.1				
	ML-SILT (TILL): as above, dry			9CS		
	-3 inch thick sand seam at high core angle, trace gravel, silt, very moist					
	-very hard			10CS		
				11CS		
				12CS		
60						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS WATER FOUND STATIC WATER LEVEL

STRATIGRAPHIC AND INSTRUMENTATION LOG

(OVERBURDEN)

PROJECT NAME: FORMER P.R. MALLORY PLANT SITE
HOLE DESIGNATION: OW4A-86

PROJECT NO.: 1916
DATE COMPLETED: DECEMBER 21, 1986

CLIENT: DART & KRAFT
DRILLING METHOD: H.S.A. CONTINUOUS

LOCATION: NORTHWEST OF EXCAVATION
CRA SUPERVISOR: L. LEMON

DEPTH ft BG	STRATIGRAPHY DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
60		729.9				
65			cement/ bentonite grout	13CS		
70				14CS		
75				15CS		
80	-4 inch: FINE SAND SEAM, angular core intersection			16CS		
85				17CS		
90				18CS		
95				19CS		
100				20CS		
105	SP-SAND: fine to medium, well sorted, trace silt, uniform, quartz rich, gray	684.9	bentonite quick gel	21CS		
110	ML-SILT: trace clay, thinly laminated		sand pack	22CS		
	-coarse gravel in split spoon	677.1	no. 10 slot screen	23SS		170
115	END OF HOLE AT 112.8 FT. BGS		Screen Details:			
	NOTE: HOLE ADVANCE FROM 107.8 to 112.8 by augering without sampler		Set screen to 112.4' (Elev. 677.5) Length - 5' Diameter - 2" Stainless Steel continuous			
120						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS WATER FOUND STATIC WATER LEVEL

STRATIGRAPHIC AND INSTRUMENTATION LOG

(OVERBURDEN)

PROJECT NAME: FORMER P.R. MALLORY PLANT SITE
HOLE DESIGNATION: OW4B-86

PROJECT NO.: 1916
DATE COMPLETED: DECEMBER 22, 1986

CLIENT: DART & KRAFT
DRILLING METHOD: H.S.A. CONTINUOUS

LOCATION: NORTHWEST OF EXCAVATION
CRA SUPERVISOR: L. LEMON

DEPTH ft BG	STRATIGRAPHY DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
0		792.27 790.4	locking cap protective casing			
	FOR STRATIGRAPHIC DETAIL REFER TO STRATIGRAPHY AND INSTRUMENTATION LOG (OVERBURDEN) FOR OW4A-86					
5			2"Ø Stainless Steel pipe			
10						
15			cement/ bentonite grout			
20						
25						
30			bentonite pellet seal			
35	-sand beds -sand beds -sand beds		sand pack			
40	ML-SILT (TILL): trace clay, little sand, gravel, occasional thin sandy parting, dark gray, hard, very slightly moist		no. 10 slot screen	1CS		
45	END OF HOLE AT 43 FT. BGS	747.4	Screen Details: Set screen to 41' (Elev. 749.4) Length - 5' Diameter - 2" Stainless Steel continuous			
50						
55	NOTE: HOLE CONTINUOUSLY SAMPLED FOR EASE OF DRILLING, NOT LOGGED IN DETAIL					
60						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS WATER FOUND STATIC WATER LEVEL

S T R A T I G R A P H I C A N D I N S T R U M E N T A T I O N L O G

(O V E R B U R D E N)

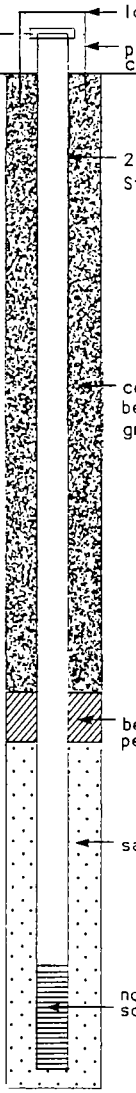
PROJECT NAME: FORMER P.R. MALLORY PLANT SITE
HOLE DESIGNATION: OW5-86

PROJECT NO.: 1916
DATE COMPLETED: DECEMBER 18, 1986

CLIENT: DART & KRAFT
DRILLING METHOD: H.S.A. CONTINUOUS

LOCATION: NORTHWEST CORNER
CRA SUPERVISOR: L. LEMON

DEPTH ft BG	STRATIGRAPHY DESCRIPTION & REMARKS	ELEVATION ft AMSL
0		793.8 791.2
5	ML-SILT (TILL?): trace clay, little sand, soft, blocky, very firm, brown with gray mottling, moist, weathered ML-SILT (TILL): trace to little clay, some sand, trace organics, gravel, brown, mottled, weathered, moist	
10		
15	SP-SAND (TILL): some silt, trace clay, brown to black, very moist ML-SILT (TILL): as above, gradually becomes harder and gray	773.7
20	ML-SILT (TILL): trace to little clay, gravel, little to some sand, dark gray, very hard, friable, uniform, dry to very slightly moist	
25	-occasional very fine sand partings	
30	-thin sand seam at 28.5 FT. BGS -evidence of closed fractures, variable orientations, black coating on surfaces and around pebbles	
35	-2 inch: medium sand layer, moist -some gravel, very hard, dry	
40	-thin sand seam, sharp high angle contact partially washed out, wet	
45		
50	END OF HOLE AT 49 FT. BGS	742.2
55		
60		



Screen Details:

Set screen to 48' (Elev. 743.2)
Length - 5'-4"
Diameter - 2"
Stainless Steel continuous

SAMPLE NUMBER	STATE	'N' VALUE
1CS		
2CS		
3CS		
4CS		
5CS		
6CS		
7CS		
8CS		
9CS		
10CS		

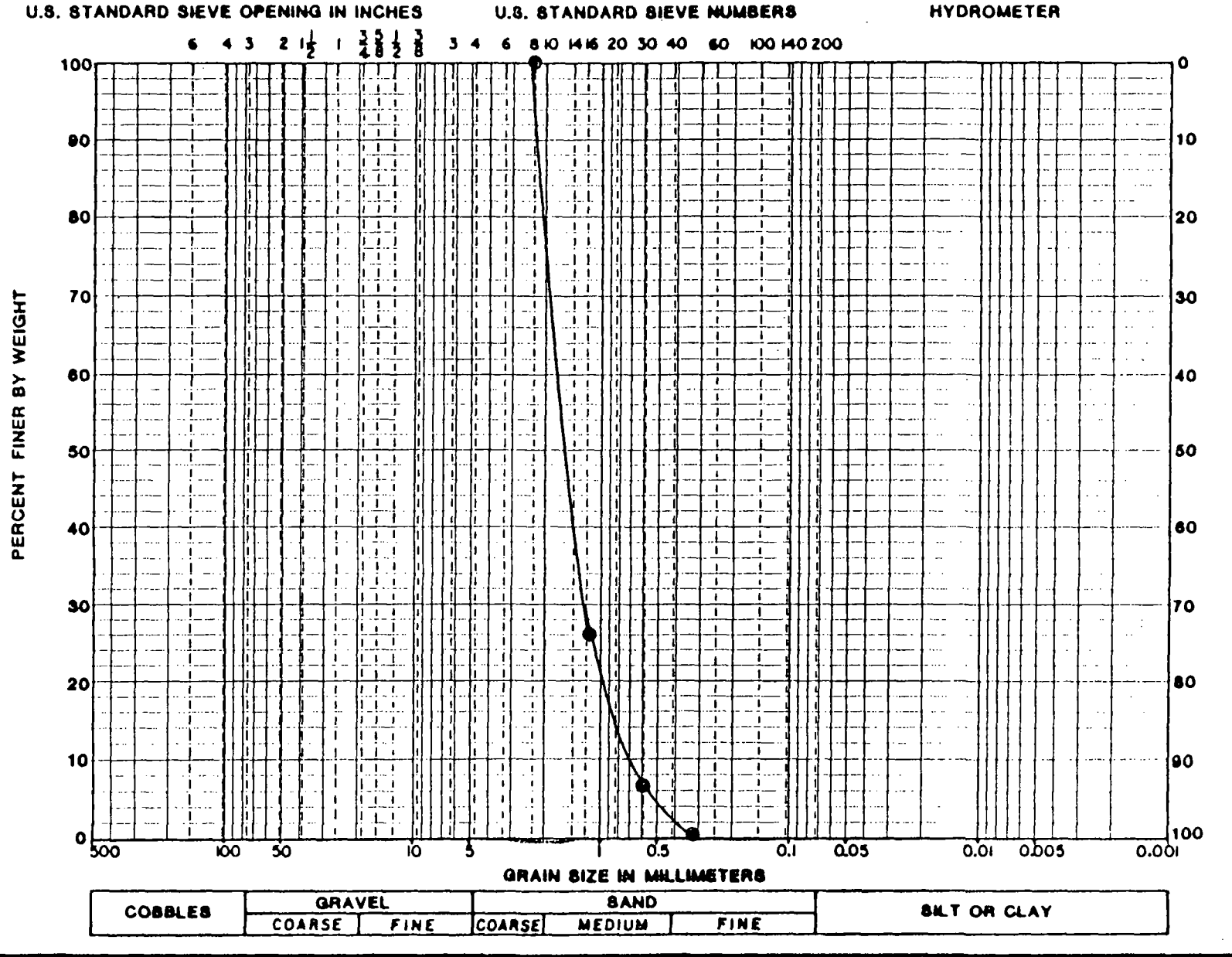
NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

GRAIN SIZE ANALYSIS WATER FOUND STATIC WATER LEVEL

APPENDIX B

GRAIN SIZE DISTRIBUTION CURVES

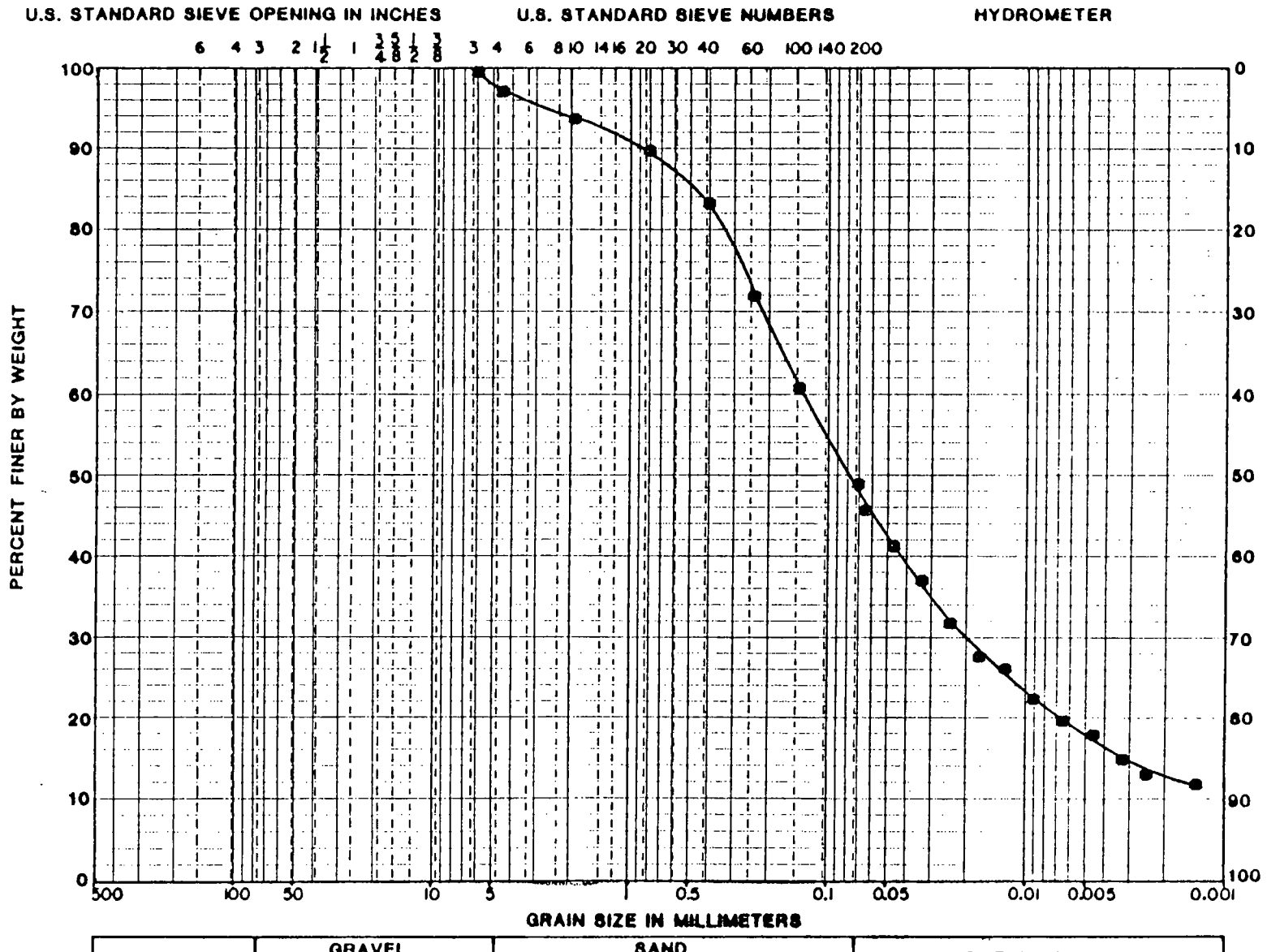
GRADATION CURVES



SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI	PROJECT
		Winter Brothers Sand Co.					Standard gravel pack sample
		WB 35					BORING NO.
							DATE
							GEOTECHNOLOGY ST LOUIS, MISSOURI

PLATE

GRADATION CURVES



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
3ACS	8.5-9.5	Silty, medium to fine SAND	14.4			

PROJECT DART KRAFT

BORING NO. OW1A-86

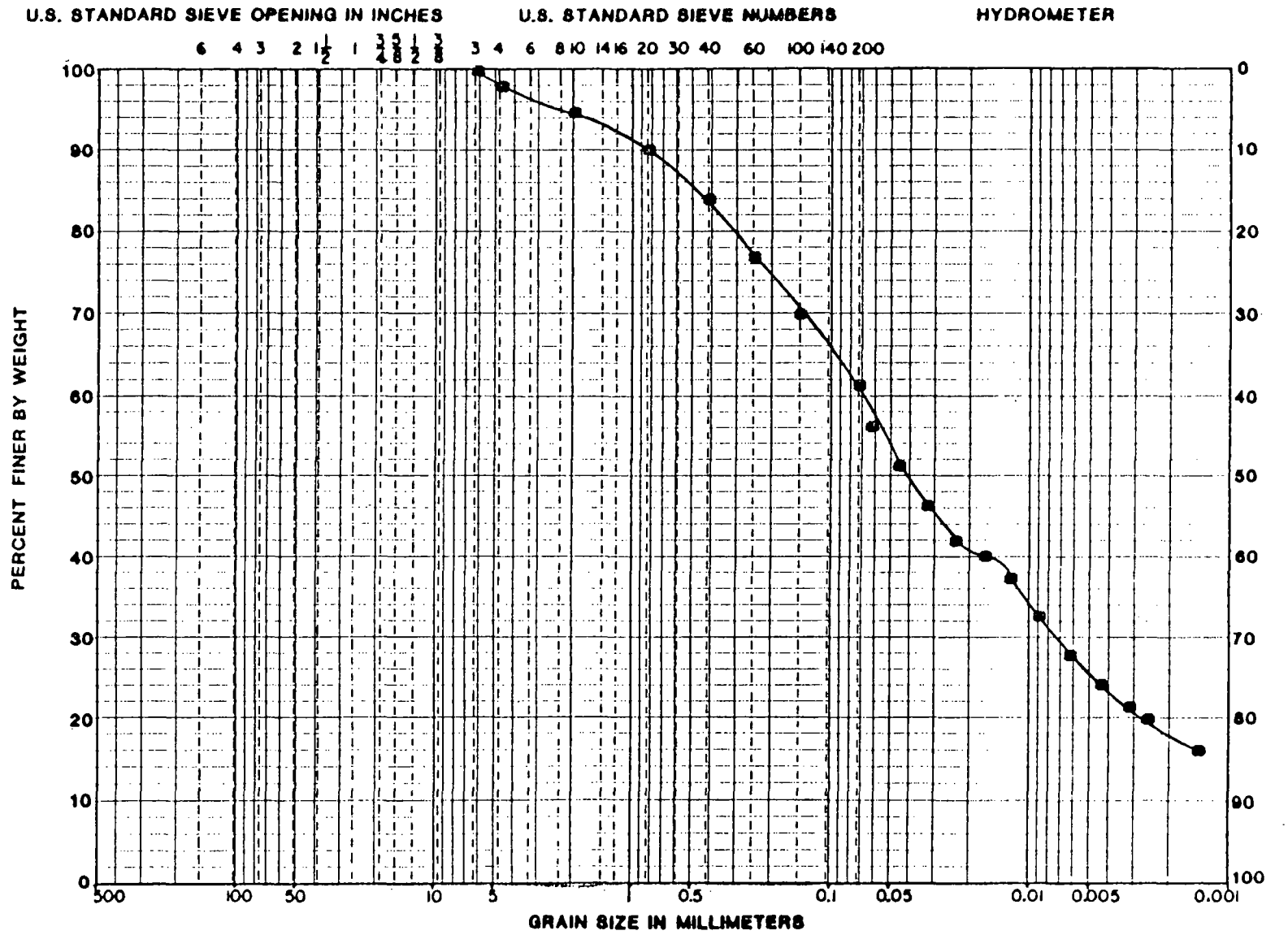
DATE 1-2-86

GEOTECHNOLOGY
ST LOUIS, MISSOURI

86485.05

PLATE

GRADATION CURVES



SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
SCS	38-43	Clayey, sandy SILT	9.0			

PROJECT DART KRAFT

BORING NO. CW1A-86

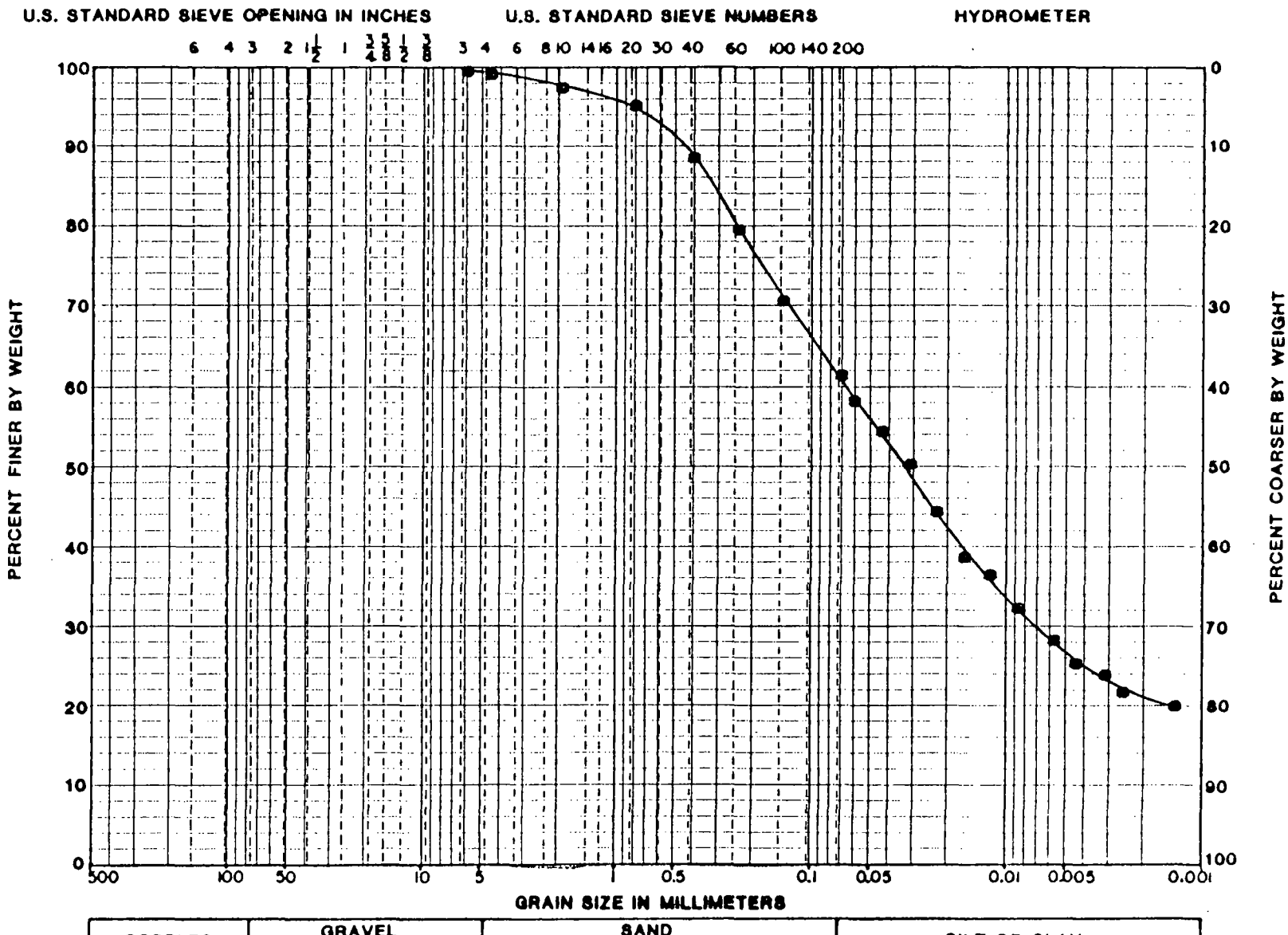
DATE 1-2-86

GEOTECHNOLOGY
ST. LOUIS, MISSOURI

96485.05

PLATE

GRADATION CURVES



SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
24CS	108-113	Clayey, silty SAND	14.2			

PROJECT DART KRAFT

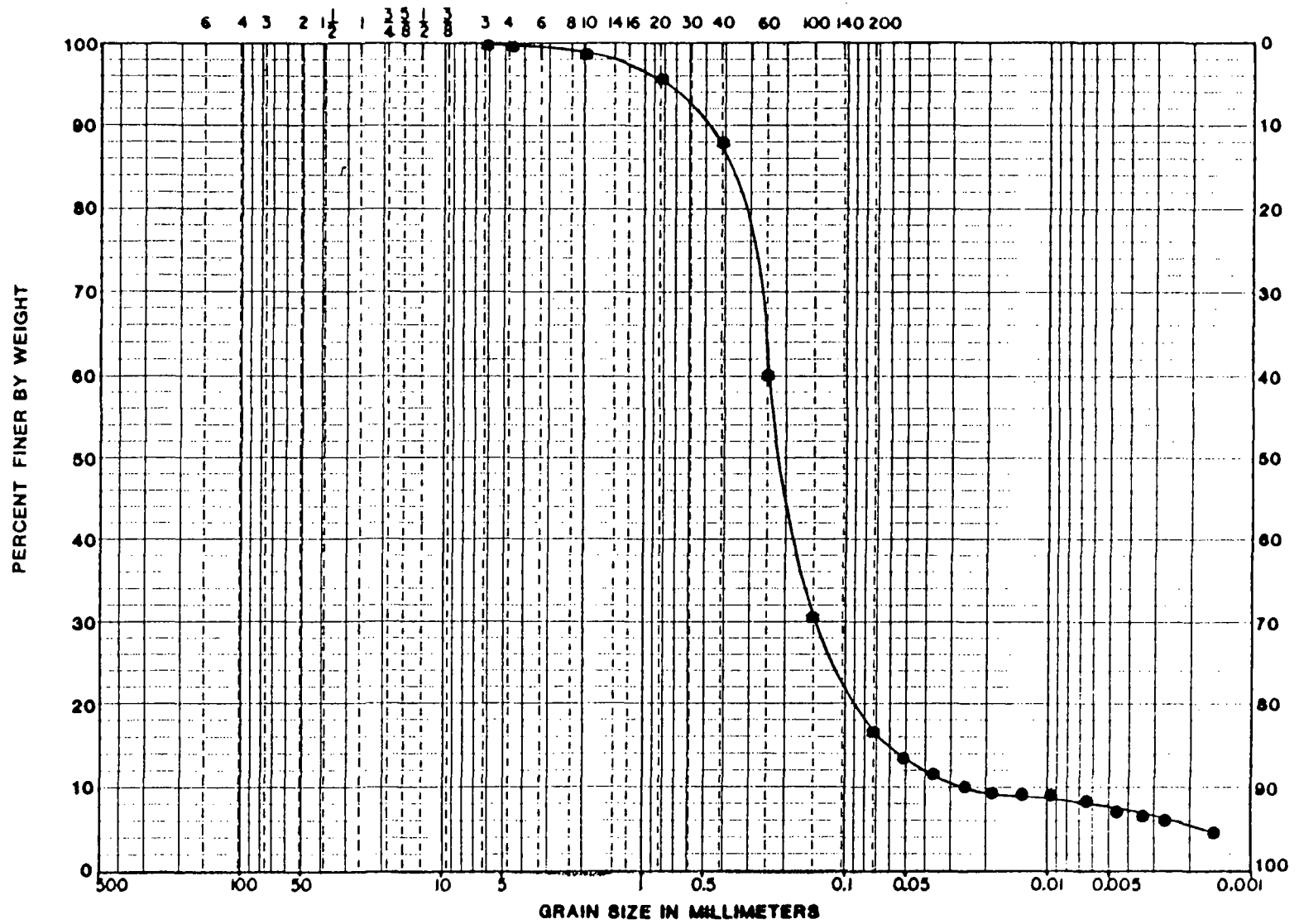
BORING NO. OW1A-86

DATE 1-2-86

GEOTECHNOLOGY
ST. LOUIS, MISSOURI

86485.05

GRADATION CURVES



SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
25ACS	113-116.5	Silty, medium to fine SAND	16.6			

PROJECT DART KRAFT

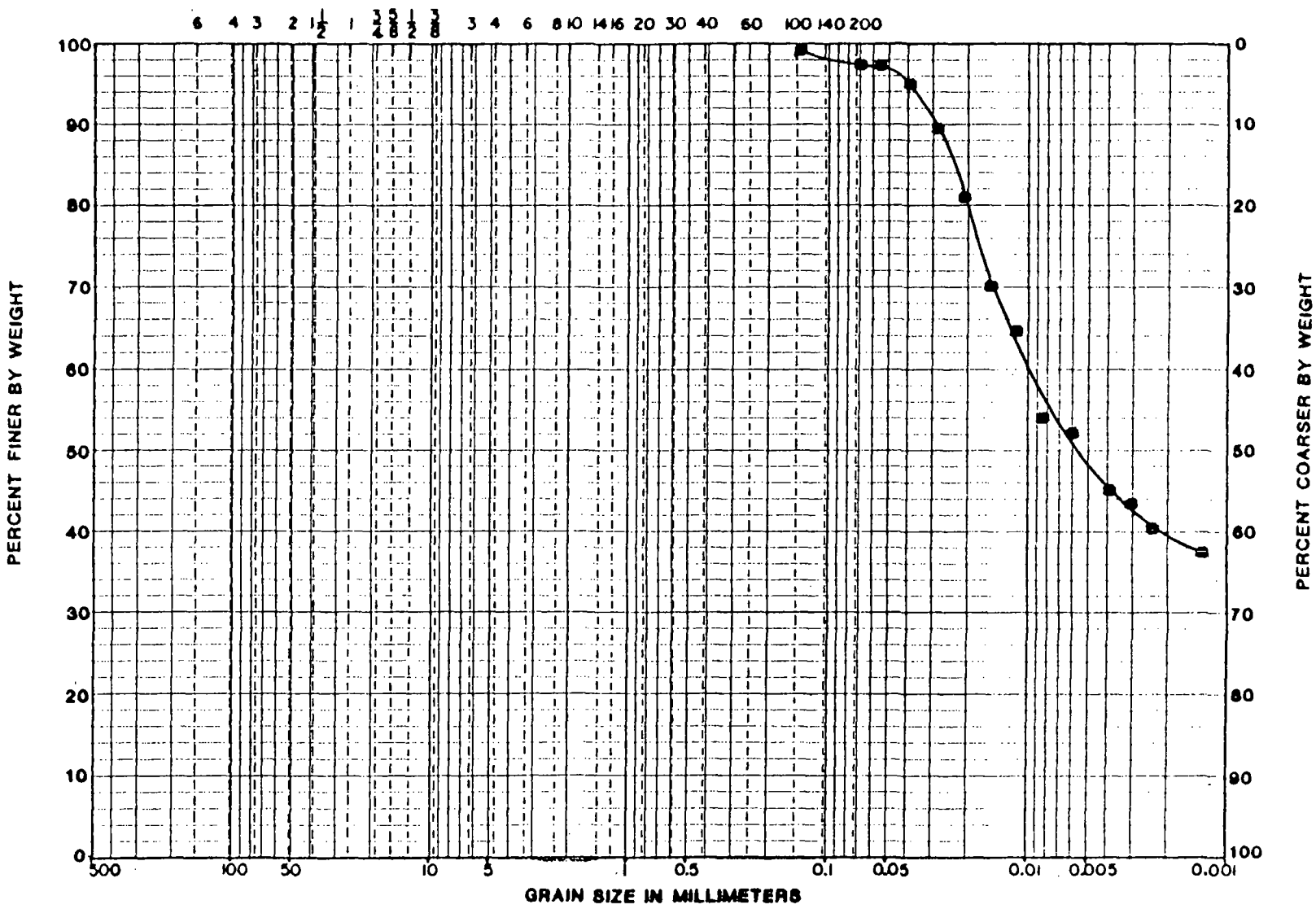
BORING NO. OW1A-86

DATE 1-2-86

GEOTECHNOLOGY
ST. LOUIS, MISSOURI

86485.05

GRADATION CURVES



86485.05

SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
2ACS	3-5.5	Gray, clayey SILT	28.4			

PROJECT DART KRAFT

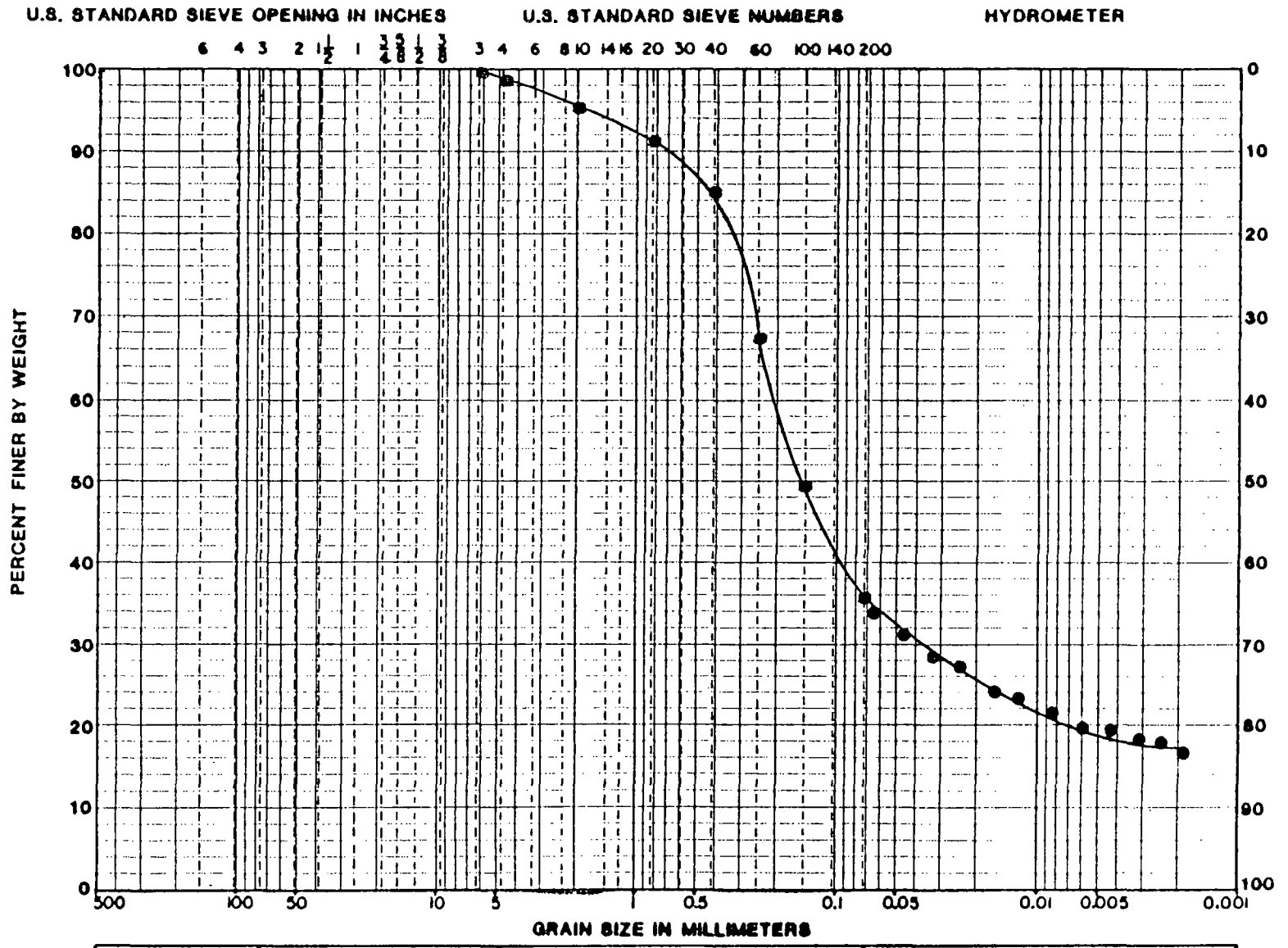
BORING NO. OW2-86

DATE 1-2-86

GEOTECHNOLOGY
ST LOUIS, MISSOURI

PLATE

GRADATION CURVES



SAMPLE NO.	EL. or DEPTH	CLASSIFICATION	NAT.WT.%	LL	PL	PI
8BCS	32.3-33	Silty, medium to fine SAND	13.1			

PROJECT DART KRAFT

BORING NO. OW2-86

DATE 1-2-86

GEOTECHNOLOGY
ST LOUIS, MISSOURI

8648S.05

APPENDIX C

RESPONSE TEST DATA

SINGLE WELL RESPONSE TEST - DATA

DATE (D/M/Y)	PAGE No.	FILE No. CODE
08 01 87	1 OF 1	1916

PROJECT	PIEZOMETER NUMBER
ORMER P.R. MALLORY PLANT SITE	OW1A-86

LOCATION	WELL DIA.	BOREHOLE DIA.
CRAWFORDSVILLE	5.08 cm	23.5 cm

CRA SUPERVISOR	SLUG DIMENSIONS (L X Ø)	SLUG DISPLACEMENT (H-Ho)	SCREEN INTERVAL
L. LEMON	WATER DISPLACED		115.3 TO 120.3 B.D.

AQUIFER THICKNESS	DATUM POINT	DATUM POINT ELEV.	STATIC WATER LEVEL CONDITIONS (H)
	T.O.C.	798.08 ftAMSL	ft B.D. [X] RISING [ ] FALLING

RUN 1

TIME			WATER LEVEL (h)	H-h	$\frac{H-h}{H-Ho}$
HR.	MIN.	SEC.			
0	0	0	118.94		
0	23		118.68		
1	16		118.06		
6	4		114.77		
7	31		113.97		

RUN 2

TIME			WATER LEVEL (h)	H-h	$\frac{H-h}{H-Ho}$
HR.	MIN.	SEC.			

SINGLE WELL RESPONSE TEST - DATA

DATE (D/M/Y)	PAGE No.	FILE No. CODE
7 1 87	1 OF 1	1916

PROJECT	PIEZOMETER NUMBER
FORMER P.R. MALLORY PLANT SITE	OW18-86

LOCATION	WELL DIA.	BOREHOLE DIA.
CRAWFORDSVILLE	5.08 cm	23.5 cm

CRA SUPERVISOR	SLUG DIMENSIONS (L X Ø)	SLUG DISPLACEMENT (H-Ho)	SCREEN INTERVAL
L. LEMON	WATER REMOVED	8.43 ft	15.3 TO 20.3 B.D.

AQUIFER THICKNESS	DATUM POINT	DATUM POINT ELEV.	STATIC WATER LEVEL CONDITIONS
	T.O.C.	797.49 ft AMSL	(H) 8.4 ft B.D. [X] RISING [ ] FALLING

RUN 1

TIME			WATER LEVEL (h)	H-h	$\frac{H-h}{H-Ho}$
HR.	MIN.	SEC.			
		0	16.83	8.43	1.0
	5	05	16.25	7.85	0.931
	12	45	15.44	7.04	0.835
	19	55	14.33	5.93	0.703
1	04	35	10.42	2.02	0.239
1	26	0	9.75	1.35	0.160
1	42	45	9.42	1.02	0.121
1	53	05	9.17	0.77	0.091

RUN 2

TIME			WATER LEVEL (h)	H-h	$\frac{H-h}{H-Ho}$
HR.	MIN.	SEC.			

SINGLE WELL RESPONSE TEST - DATA

DATE (D/M/Y)	PAGE No.	FILE No. CODE
05 01 87	1 OF 1	1916

PROJECT	PIEZOMETER NUMBER
FORMER P.R. MALLORY PLANT SITE	OW2-86

LOCATION	WELL DIA.	BOREHOLE DIA.
CRAWFORDSVILLE	5.08 m	23.5 cm

CRA SUPERVISOR	SLUG DIMENSIONS (L X Ø)	SLUG DISPLACEMENT (H-Ho)	SCREEN INTERVAL
L. LEMON	WATER REMOVED	17.5 ft 5.334 m	L = 1.54 m 30.3 TO 35.3 B.D.

AQUIFER THICKNESS	DATUM POINT	DATUM POINT ELEV.	STATIC WATER LEVEL CONDITIONS
	T.O.C.	798.27 ft AMSL	(H) 9.98 ft B.D. [X] RISING [ ] FALLING

RUN 1

TIME			WATER LEVEL (h)	H-h	$\frac{H-h}{H-Ho}$
HR.	MIN.	SEC.			
		0	27.48	17.5ft	1.0
		30	25.84	15.86	0.906
	1	0	25.45	15.47	0.884
	1	30	25.21	15.23	0.870
	2	00	24.91	14.93	0.853
	2	30	24.59	14.61	0.835
	3	00	24.32	14.34	0.819
	4	00	23.68	13.7	0.783
	5	06	23.08	13.1	0.749
	6	00	22.56	12.58	0.719
	7	30	21.83	11.85	0.677
	9	00	21.13	11.15	0.637
	10	00	20.67	10.69	0.611
	12	30	19.57	9.59	0.548
	15	00	18.64	8.66	0.495
	20	00	17.11	7.13	0.407
	25	30	15.79	5.81	0.332
	30	00	14.94	4.96	0.283
	41	10	13.52	3.54	0.202
	50	00	12.85	2.87	0.164
1	02		12.3	1.98	0.113
1	15		11.96	1.98	0.113

RUN 2

TIME			WATER LEVEL (h)	H-h	$\frac{H-h}{H-Ho}$
HR.	MIN.	SEC.			
		0		16.24	1.0
		30		14.6	0.899
	1			14.21	0.875
	1	30		13.97	0.860
	2			13.67	0.842
	2	30		13.35	0.822
	3			13.08	0.805
	4			12.44	0.766
	5			11.84	0.729
	6			11.32	0.697
	7	30		10.59	0.652
	9			9.89	0.609
	10			9.43	0.581
	12	30		8.33	0.513
	15			7.4	0.456
	20			5.87	0.361
	25	30		4.55	0.280
	30			3.7	0.228
	41	10		2.28	0.140
	50			1.61	0.099
1	02			1.06	0.065
1	15			0.72	0.044

SINGLE WELL RESPONSE TEST - DATA

DATE (D/M/Y)	PAGE No.	FILE No. CODE
07 1 87	1 OF 1	1916

PROJECT	PIEZOMETER NUMBER
FORMER P.R. MALLORY PLANT SITE	OW3-86

LOCATION	WELL DIA.	BOREHOLE DIA.
CRAWFORDSVILLE	5.08 cm	23.5 cm

CRA SUPERVISOR	SLUG DIMENSIONS (LXØ)	SLUG DISPLACEMENT (H-Ho)	SCREEN INTERVAL
L. LEMON	WATER REMOVED	18.21	32.8 TO 37.8 B.D.

AQUIFER THICKNESS	DATUM POINT	DATUM POINT ELEV.	STATIC WATER LEVEL CONDITIONS (H)
	T.O.C.	794.72 ft AMSL	14.06 B.D. [X] RISING [ ] FALLING

RUN 1

TIME			WATER LEVEL (h)	H-h	$\frac{H-h}{H-Ho}$
HR.	MIN.	SEC.			
	0		32.27	18.21	1.0
	26		29.54	15.48	0.850
2	48	30	22.15	8.09	0.443

RUN 2

TIME			WATER LEVEL (h)	H-h	$\frac{H-h}{H-Ho}$
HR.	MIN.	SEC.			

SINGLE WELL RESPONSE TEST - DATA

DATE (D/M/Y)	PAGE No.	FILE No. CODE
07 | 1 | 87	1 OF 1	1916 |

PROJECT	PIEZOMETER NUMBER
FORMER P.R. MALLORY PLANT SITE	OW4B-86

LOCATION	WELL DIA.	BOREHOLE DIA.
CRAWFORDSVILLE	5.08 cm	23.5 cm

CRA SUPERVISOR	SLUG DIMENSIONS (L X Ø)	SLUG DISPLACEMENT (H-Ho)	SCREEN INTERVAL
L. LEMON	WATER REMOVED	16.08 ft	37.8 TO 42.8 B.D.

AQUIFER THICKNESS	DATUM POINT	DATUM POINT ELEV.	STATIC WATER LEVEL CONDITIONS (H)	
	T.O.C.	792.27 ft AMSL	22.2 ft B.D.	[x] RISING [ ] FALLING

RUN 1

TIME			WATER LEVEL (h)	H-h	$\frac{H-h}{H-Ho}$
HR.	MIN.	SEC.			
	0	0	38.28	16.08	1.0
	1	30	38.24	16.04	0.998
	12	30	38.07	15.87	0.987
	37	30	36.55	14.35	0.893
2	53	30	32.74	10.54	0.655
4	0	30	31.45	9.25	0.575

RUN 2

TIME			WATER LEVEL (h)	H-h	$\frac{H-h}{H-Ho}$
HR.	MIN.	SEC.			

SINGLE WELL RESPONSE TEST - DATA

DATE (D/M/Y)	PAGE No.	FILE No. CODE
07 | 1 | 87	1 OF 1	1916 |

PROJECT	PIEZOMETER NUMBER
FORMER P.R. MALLORY PLANT SITE	OW5-86

LOCATION	WELL DIA.	BOREHOLE DIA.
CRAWFORDSVILLE	5.08 cm	23.5 cm

CRA SUPERVISOR	SLUG DIMENSIONS (L X Ø)	SLUG DISPLACEMENT (H-Ho)	SCREEN INTERVAL
L. LEMON	WATER REMOVED	29.77 ft	45.3 TO 50.3 B.D.

AQUIFER THICKNESS	DATUM POINT	DATUM POINT ELEV.	STATIC WATER LEVEL CONDITIONS
	T.O.C.	793.08 ft AMSL	(H) 13.8 ft B.D. [X] RISING [ ] FALLING

RUN 1

TIME			WATER LEVEL (h)	H-h	$\frac{H-h}{H-Ho}$
HR.	MIN.	SEC.			
	0	0	43.57	29.77	1.0
	2		43.39	29.59	0.994
	36	0	40.70	26.9	0.904
2	51	0	32.64	18.84	0.633
4	0	0	29.54	15.74	0.528
4	37	0	28.10	14.3	0.480

RUN 2

TIME			WATER LEVEL (h)	H-h	$\frac{H-h}{H-Ho}$
HR.	MIN.	SEC.			

APPENDIX D

MAGNETOMETER SURVEY DATA

LINE 0 (Base Line) (1916)

Station	Reading 1	Reading 2	Average	Comments
1	58259	58874	58567	
2 W	55870	55870	55870	
3 W	55767	55763	55765	
3 1/2 W	55726	55737	55732	
4 W	55241	55235	55238	
4 1/2 W	55408	55534	55471	
5 W	55598	55662	55630	
5 1/2 W	55827	55834	55831	
6 W	56063	56045	56054	
7 W	56359	56360	56360	scrap metal
8 W	56597	56610	56607	
9 W	56396	56409	56403	
10 W	56129	56129	56129	
11 W	55992	55994	55993	
12 W	55506	55503	55504	3 feet from fence
fence	59993		59993	

LINE +20 N

Station	Reading 1	Reading 2	Average	Comments
1	57574	57472	57523	
2 W	55892	55892	55892	
3 W	56020	56020	56020	
4 W	56144	56144	56144	
5 W	56135	56136	56136	concrete pipe holders
6 W	56156	56156	56156	
7 W	56961	56970	56966	
7 1/2 W	58060	58559	58310	near well house
8 W	59088	57116	58102	near well house
8 1/2 W	58802	58856	58829	near well house
9 W	56827	56818	56823	
10 W	56107	56100	56104	
11 W	55954	55954	55954	
12 W	56198	56207	56203	

LINE +40 N

Station	Reading 1	Reading 2	Average	Comments
1	57086	58207	57638	
2 W	55922	55918	55920	
3 W	56051	56050	56050	
4 W	55606	55597	55602	
5 W	56046	56046	56046	
6 W	56041	56040	56041	
7 W	56384	56373	56379	
8 W	57202	57256	57229	north of pumphouse
9 W	56147	56143	56145	
10 W	56954	55953	55954	
11 W	55877	55881	55879	
12 W	58143	57452	57798	

LINE +60 N

Station	Reading 1	Reading 2	Average	Comments
1	57876	56763	57320	
2 W	55932	55933	55932	
3 W	56602	56600	56601	east of incinerator
4 W	56202	56208	56205	
5 W	56128	56123	56125	
6 W	57633	59324	58479	- fence
7 W	55937	55935	55936	
8 W	56122	56117	56119	north of pumphouse
9 W	58210	58231	58221	- coiled wire
10 W	55822	55822	55822	
11 W	55783	55785	55784	
12 W	56034	56336	56185	

LINE +80 N

Station	Reading 1	Reading 2	Average	Comments
1	59038	57011	58025	
2 W	55934	55936	55935	
3 W	55662	55653	55658	
3 1/2 W	55992	56003	55998	roadway
4 W	57256	57262	57259	roadway
4 1/2 W	57650	57720	57685	roadway
5 W	56419	56425	56422	metal pail
6 W	56050	56045	56048	fence
7 W	55951	55951	55951	
8 W	55944	55946	55945	
9 W	55977	55978	55978	
10 W	55974	55979	55977	
11 W	55918	55919	55918	
12 W	55839	57825	56832	

LINE +100 N

Station	Reading 1	Reading 2	Average	Comments
5 E	57534	58191	57863	
4 E	56514	56684	56599	
3 E	55495	55485	55490	
2 E	55551	55555	55553	
1	55077	55155	55116	
1	55117	55299	55208	
2 W	55944	55944	55944	
3 W	55934	55936	55935	
3 1/2 W	56334	56332	56333	
4 W	57500	57454	57473	
4 1/2 W	59168	59161	59164	anomalous reading
5 W	55834	55839	55836	
6 W	55961	55961	55961	
7 W	55990	55989	55990	
8 W	56000	56001	56000	
9 W	56011	56010	56010	
10 W	56134	56010	56072	
11 W	55943	55946	55944	
12 W	57670	57345	57508	

LINE +120 N

Station	Reading 1	Reading 2	Average	Comments
6 E	57459	58803	58106	creek at fence
5 1/2 E	56546	55839	56193	
5 E	55364	54908	55136	trace metal
4 1/2 E	54203	54255	54229	
4 E	55642	55584	55613	edge of ravine
3 E	55838	55843	55840	
2 E	56441	56489	56465	rubbish pile
1	55469	55608	55539	5 feet southeast of OW3
1	55663	55688	55675	
2 W	56020	56021	56020	road
3 W	55885	55884	55884	road
4 W	55293	55305	55299	
5 W	55501	55524	55512	
6 W	55982	55981	55982	fence
7 W	56038	56038	56038	
8 W	56061	56061	56061	
9 W	56062	56066	56064	
10 W	56055	56059	56057	
11 W	55997	55997	55997	
12 W	57634	57594	57614	

LINE +140 N

Station	Reading 1	Reading 2	Average	Comments
6 E	54839	54845	54842	
5 E	54981	54985	54983	
4 E	55559	55560	55560	trace metal
3 E	55918	55920	55919	edge of ravine
2 E	56001	56004	56002	
1	56132	56134	56133	
1	56154	56151	56152	
2 W	56106	56105	56106	
3 W	56066	56068	56067	
4 W	56059	56059	56059	
5 W	56053	56052	56052	
6 W	56071	56067	56069	fence
7 W	56098	56100	56099	
8 W	56106	56111	56108	
9 W	56104	56102	56103	
10 W	56096	56096	56096	
11 W	56027	56025	56028	
12 W	57200	58210	57700	

LINE +160 N

Station	Reading 1	Reading 2	Average	Comments
7 E	57751	57764	57758	
6 E	55733	55732	55732	edge of ravine
5 E	55975	55975	55975	
4 E	55982	55983	55982	creek
3 E	56049	56051	56050	edge of ravine
2 E	56011	56012	56012	edge of liner
1	56081	56078	56080	
1	56070	56072	56071	
2 W	56147	56148	56148	
3 W	56153	56153	56153	
4 W	56149	56147	56148	
5 W	56181	56144	56163	
6 W	56335	56340	56338	fence
7 W	56112	56108	56110	
8 W	56116	56118	56117	
9 W	56122	56122	56122	
10 W	56111	56112	56112	
11 W	56069	56071	56070	
12 W	58388	56639	51514	

LINE +180 N

Station	Reading 1	Reading 2	Average	Comments
7 E	55755	55765	55760	
6 E	56026	56150	56088	
5 E	56091	56090	56090	bottom of ravine
4 E	56070	56075	56073	edge of liner
3 E	56061	56062	56062	
2 E	56083	56081	56082	ravine in liner
1	56251	56252	56252	edge of liner
1	56268	56270	56269	
2 W	56195	56193	56194	
3 W	56316	56315	56316	
4 W	56151	56151	56151	
5 W	56125	56151	56125	
6 W	56114	56120	56117	fence
7 W	56124	56127	56126	
8 W	56134	56139	56136	
9 W	56124	56127	56125	
10 W	56117	56117	56117	
11 W	56049	56050	56050	
12 W	56104	56204	56154	

LINE +200 N

Station	Reading 1	Reading 2	Average	Comments
7 E	55632	55637	55635	
6 E	56036	56033	56035	
5 E	56149	56148	56148	bottom of ravine
4 E	56151	56153	56152	edge of liner
3 E	56121	56122	56122	
2 E	56128	56129	56128	crest of liner
1	56125	56124	56124	
1	56119	56120	56120	
2 W	56066	56062	56064	
3 W	56997	55997	56997	
4 W	56430	56431	56430	south of car (10 feet)
5 W	56127	56128	56128	
6 W	56137	56140	56139	fence
7 W	56128	56126	56127	
8 W	56137	56137	56137	
9 W	56135	56136	56135	
10 W	56122	56124	56123	
11 W	56078	56081	56080	
12 W	57020	56376	56698	

LINE +220 N

Station	Reading 1	Reading 2	Average	Comments
7 E	56015	56006	56008	
6 E	56100	56102	56101	
5 E	56307	56862	56584	creek bed, wire
4 E	56076	56077	56077	
3 E	56101	56103	56102	
2 E	56140	56139	56140	
1	56119	56115	56117	
1	56117	56119	56118	on liner
2 W	56104	56106	56105	
3 W	55521	55531	55526	15 feet from car
4 W	56137	56542	56340	west of car
5 W	56033	56034	56034	
6 W	56108	56109	56108	
7 W	56136	56141	56138	
8 W	56152	56152	56152	
9 W	56147	56150	56148	
10 W	56140	56143	56141	
11 W	56079	56079	56079	
12 W	57669	56674	55672	

LINE +240 N

Station	Reading 1	Reading 2	Average	Comments
7 E	58370	58624	58497	
6 E	56081	56083	56082	
5 E	56107	56112	56110	edge of ravine
4 E	56171	56187	56179	creek bed
3 E	56120	56120	56120	edge of liner
2 E	56141	56139	56140	top of ravine
1	56140	56140	56140	
1	56149	56148	56148	
2 W	56054	56054	56054	
3 W	56014	56015	56014	
4 W	55729	56711	56720	between car and OW4-86
5 W	56101	56102	56102	
6 W	56186	56171	56179	fence
7 W	56160	56161	56160	
8 W	56163	56164	56164	
9 W	56154	56155	56155	
10 W	56146	56148	56147	
11 W	56096	56094	56095	
12 W	55775	55777	55776	

LINE +260 N

Station	Reading 1	Reading 2	Average	Comments
7 E	57867	57663	57765	
6 E	56055	56061	56058	top of ravine
5 E	56116	56118	56117	
4 E	56138	56133	56135	creek
3 E	56124	56129	56126	
2 E	56147	56149	56148	
1	56141	56142	56142	liner
2 W	56159	56161	56160	liner
3 W	56167	56168	56168	edge of liner
4 W	56094	56091	56092	6 feet northeast of OW4A
5 W	56185	56188	56186	
6 W	56174	56175	56174	fence line
7 W	56173	56173	56173	
8 W	56165	56164	56164	
9 W	56169	56169	56169	
10 W	56149	56148	56148	
11 W	56099	56102	56101	
12 W	57966	57287	57627	

LINE +280 N

Station	Reading 1	Reading 2	Average	Comments
6 E	55793	56796	55794	
5 E	56176	56179	56178	
4 E	56130	56131	56130	
3 E	56144	56144	56144	
2 E	56146	56147	56146	
1	56136	56136	56136	
2 W	56126	56127	56126	
3 W	56142	56142	56142	edge of ravine, liner
4 W	56180	56177	56178	
5 W	56188	56186	56187	
6 W	56183	56185	56184	fence
7 W	56154	56155	56154	
8 W	56149	56151	56150	
9 W	56156	56153	56154	
10 W	56148	56148	56148	
11 W	55769	55789	55779	3 feet north of OW5
12 W	57384	57571	57478	

LINE +300 N

Station	Reading 1	Reading 2	Average	Comments
5 E	55750	55735	55742	
4 E	56113	56115	56114	bottom of ravine
3 E	56120	56121	56120	
2 E	56141	56138	56140	creek
1	56153	56153	56153	
2 W	56140	56138	56139	edge of liner
3 W	56137	56137	56137	ceramic tile
4 W	56161	56158	56160	
5 W	56185	56181	56183	
6 W	56182	56170	56176	
7 W	56151	56145	56148	
8 W	56145	56144	56144	
9 W	56129	56130	56130	
10 W	56070	56072	56071	
11 W	55903	5907	55905	
12 W	58441	59226	58834	

LINE +320 N

Station	Reading 1	Reading 2	Average	Comments
5 E	56611	56416	56514	
4 E	56056	56060	56058	
3 E	56126	56128	56127	
2 E	56152	56156	56153	
1	56131	56131	56131	
2 W	56111	56111	56111	creek
3 W	56140	56138	56139	
4 W	56148	56148	56148	
5 W	56141	56141	56141	
6 W	56192	56194	56193	
7 W	56105	56106	56106	
8 W	56077	56080	56078	
9 W	56987	56987	55987	
10 W	56841	57519	57180	

LINE +340 N

Station	Reading 1	Reading 2	Average	Comments
5 E	57579	58574	58077	
4 E	55991	55989	55990	
3 E	56106	56107	56106	
2 E	56134	56136	56135	
1	56134	56135	56134	
2 W	56104	56105	56104	creek
3 W	56122	56122	56122	
4 W	56125	56122	56124	
5 W	56124	56128	56126	
6 W	56228	56197	56213	
7 W	56079	56081	56080	
8 W	55630	55630	55630	

LINE +360 N

Station	Reading 1	Reading 2	Average	Comments
4 E	56389	56810	56603	
3 E	56031	56030	56030	
2 E	56143	56140	56142	
1	56142	56144	56143	
2 W	56136	56130	56133	
3 W	56112	56112	56112	creek
4 W	55100	55098	55100	
5 W	55932	55935	55933	
6 W	56264	56284	56274	
7 W	57318	58921	58120	

LINE +380 N

Station	Reading 1	Reading 2	Average	Comments
3 E	55983	55984	55984	
2 E	56124	56125	56124	
1	56124	56127	56126	
2 W	56125	56130	56128	creek
3 W	56091	56090	56090	
4 W	56032	56032	56032	
5 W	55435	55440	55438	

LINE +400 N

Station	Reading 1	Reading 2	Average	Comments
3 E	58640	59052	58846	
2 E	55098	56010	55104	
1	56097	56098	56098	top of ravine
2 W	56104	56104	56104	
3 W	55028	55030	55029	edge of creek
4 W	55045	55042	55044	south of sediment trap
5 W	55493	55493	55493	

LINE +420 N

Station	Reading 1	Reading 2	Average	Comments
2 E	55884	55878	55881	
1	56057	56056	56057	
2 W	56046	56047	56046	
3 W	55675	55661	55668	
4 W	57044	57682	57363	creek

LINE +20 S

Station	Reading 1	Reading 2	Average	Comments
1	55933	55558	55796	
2 W	55350	55343	55347	
3 W	56087	56084	56086	
4 W	56236	56227	56232	
4 1/2 W	56064	56054	56059	
5 W	58076	57982	58329	
5 1/2 W	56633	56674	56654	
6 W	56376	56369	56363	
7 W	56026	56041	56034	
8 W	56131	56135	56133	
9 W	56176	56175	56175	
10 W	56095	56094	56094	
11 W	56027	56028	56028	
12 W	56095	56107	56101	

LINE +40 S

Station	Reading 1	Reading 2	Average	Comments
1	58007	56958	57483	
2 W	55499	55498	55498	road
3 W	55087	55083	55085	edge of cell
4 W	55013	54717	54895	cell
5 W	54989	55346	55168	cell
6 W	55291	55291	55291	cell
7 W	55468	55491	55486	edge of cell
8 W	56431	56429	56430	cell, drums
9 W	56005	56009	56007	
10 W	56067	56074	56070	
11 W	56020	56019	56020	
12 W	57188	56983	57086	

LINE +60 S

Station	Reading 1	Reading 2	Average	Comments
1	58642	57948	58295	
2 W	55262	55269	55265	
3 W	54696	53772	54234	edge of cell
8 W	55844	55856	55850	edge of cell
9 W	55999	55993	55996	
10 W	56066	56070	56068	
11 W	56021	56021	56021	
12 W	57894	58185	58040	

LINE +80 S

Station	Reading 1	Reading 2	Average	Comments
1	57770	56760	57265	
2 W	56201	56220	56210	
3 W	57996	57884	57940	edge of cell
8 W	56113	56116	56114	edge of cell
9 W	56085	56087	56086	
10 W	56069	56074	56072	
11 W	56022	56024	56023	
12 W	55919	55915	55917	

LINE +100 S

Station	Reading 1	Reading 2	Average	Comments
1	56620	58825	57723	
2 W	55810	55814	55812	
3 W	56313	56327	56320	east corner of cell
4 W	56370	56353	56362	cell
5 W	56434	56448	56441	cell
6 W	55982	55978	55980	cell
7 W	55995	55996	55996	cell
8 W	57732	55740	55735	west corner of cell
9 W	56035	56038	56037	
10 W	56055	56059	56057	
11 W	56025	56025	56025	
12 W	57294	59002	58148	

LINE +120 S

Station	Reading 1	Reading 2	Average	Comments
1	54990	53891	54440	
2 W	55863	55863	55863	
3 W	56019	56020	56019	
4 W	56048	56047	56048	
5 W	56062	56062	56062	
6 W	56040	56039	56040	
7 W	55726	55724	55725	
7 1/2 W	55379	55384	55381	
8 W	56031	56030	56030	
9 W	55922	55923	55922	
10 W	56114	56110	56112	
11 W	56046	56051	56048	
12 W	56929	56843	56886	

LINE +140 S

Station	Reading 1	Reading 2	Average	Comments
1	53838	53474	53656	
2 W	55848	55850	55849	
3 W	55834	55829	55832	
4 W	56013	56013	56013	
5 W	56132	56132	56132	
6 W	56097	56097	56097	
7 W	55893	55896	55894	
8 W	55969	55954	55962	
9 W	56098	56095	56097	
10 W	56062	56065	56063	
11 W	56015	56017	56016	
12 W	55750	56644	56197	

LINE +160 S

Station	Reading 1	Reading 2	Average	Comments
1	58328	58816	58572	
2 W	55716	55717	55716	
3 W	55776	55745	55761	
4 W	55890	55889	55890	
5 W	56098	56094	56096	
6 W	56045	56046	56046	
7 W	56047	56049	56048	
8 W	55952	55953	55952	
9 W	56079	56079	56079	
10 W	56019	56018	56018	
11 W	55986	55989	55988	
12 W	58651	59310	58981	

LINE +180 S

Station	Reading 1	Reading 2	Average	Comments
1	58393	57817	58105	
2 W	55514	55515	55514	
3 W	56061	56055	56058	
4 W	56805	56807	56806	
5 W	56795	56795	56795	
6 W	56934	56926	56930	
7 W	55904	55905	55904	
8 W	55445	55444	55444	north of trash container
9 W	55466	55494	55480	north of trash container
10 W	55061	55613	55337	
11 W	55997	56000	55998	
12 W	55658	55665	55662	

LINE +200 S

Station	Reading 1	Reading 2	Average	Comments
1	59126	59348	59237	
2 W	56610	57552	57081	scrap pile
3 W	55530	55530	55530	
4 W	55773	55430	55602	south of trash container
5 W	55317	55317	55317	
6 W	55749	55755	55752	
7 W	55861	55862	55862	
8 W	58258	56976	57617	east of trash container
9 W	55693	55766	55727	
10 W	55959	55959	55959	
11 W	55991	55994	55993	
12 W	55814	55810	55812	

LINE +220 S

Station	Reading 1	Reading 2	Average	Comments
1	57220	56145	56683	
2 W	55186	55185	55186	
3 W	54644	54624	54634	
4 W	58619	58922	58771	east edge of dumpster
5 W	54543	54533	54538	- near dumpster, tankers
6 W	55760	55760	55760	
7 W	55883	55883	55883	
8 W	55792	55796	55794	
9 W	55537	55516	55527	
10 W	56083	56091	56087	
11 W	56078	56074	56076	
12 W	55742	55745	55743	

LINE +240 S

Station	Reading 1	Reading 2	Average	Comments
1	58051	58284	58168	
2 W	54820	54834	54827	
3 W	55290	55293	55292	
4 W	56870	58683	57777	near tanker
5 W	54952	54347	54650	northwest of tankers
6 W	55450	55454	55452	
7 W	55669	55669	55669	
8 W	55092	55104	55098	east of dumpster
9 W	58144	58017	58081	west of dumpster
10 W	55258	55274	55266	
11 W	55944	55941	55942	
12 W	55833	55843	55838	

LINE +260 S

Station	Reading 1	Reading 2	Average	Comments
1	57290	58413	57852	
2 W	57695	57717	57706	decon pad (hi-hoe)
3 W	55498	55515	55506	
4 W	58300	57867	58084	edge of tanker
5 W	55962	56287	56125	west of tanker
6 W	55163	55471	55317	north of loader
7 W	55325	55326	55326	
8 W	57374	57302	57338	
9 W	57370	57113	57242	south of drums
10 W	56005	56007	56006	
11 W	56371	56374	56372	
12 W	55534	55519	55527	

LINE +280 S

Station	Reading 1	Reading 2	Average	Comments
1	56534	57015	56775	
2 W	54311	53395	53853	decon pad (hi-hoe)
3 W	54710	54614	54662	
4 W	54107	54198	54153	edge of tanker
5 W	55075	55902	55514	west of tanker
6 W	56557	59025	57791	loader
7 W	55488	55489	55488	
8 W	55729	55733	55731	
9 W	57381	57396	57389	drums
10 W	55899	55901	55900	
11 W	56013	56017	56015	
12 W	55560	55557	55558	

LINE +300 S

Station	Reading 1	Reading 2	Average	Comments
1	55678	55012	55345	tanks
2 W	54697	54724	54711	
3 W	55015	54653	54834	
4 W	56320	56282	56301	decon trailer
5 W	55305	55219	55262	
6 W	51937	52619	52278	U-haul truck
7 W	56088	56099	56093	
8 W	58232	57403	57818	drums
9 W	58494	57452	57473	drums
10 W	55943	55942	55942	
11 W	56005	56005	56005	
12 W	55722	55708	57715	

LINE +120 S

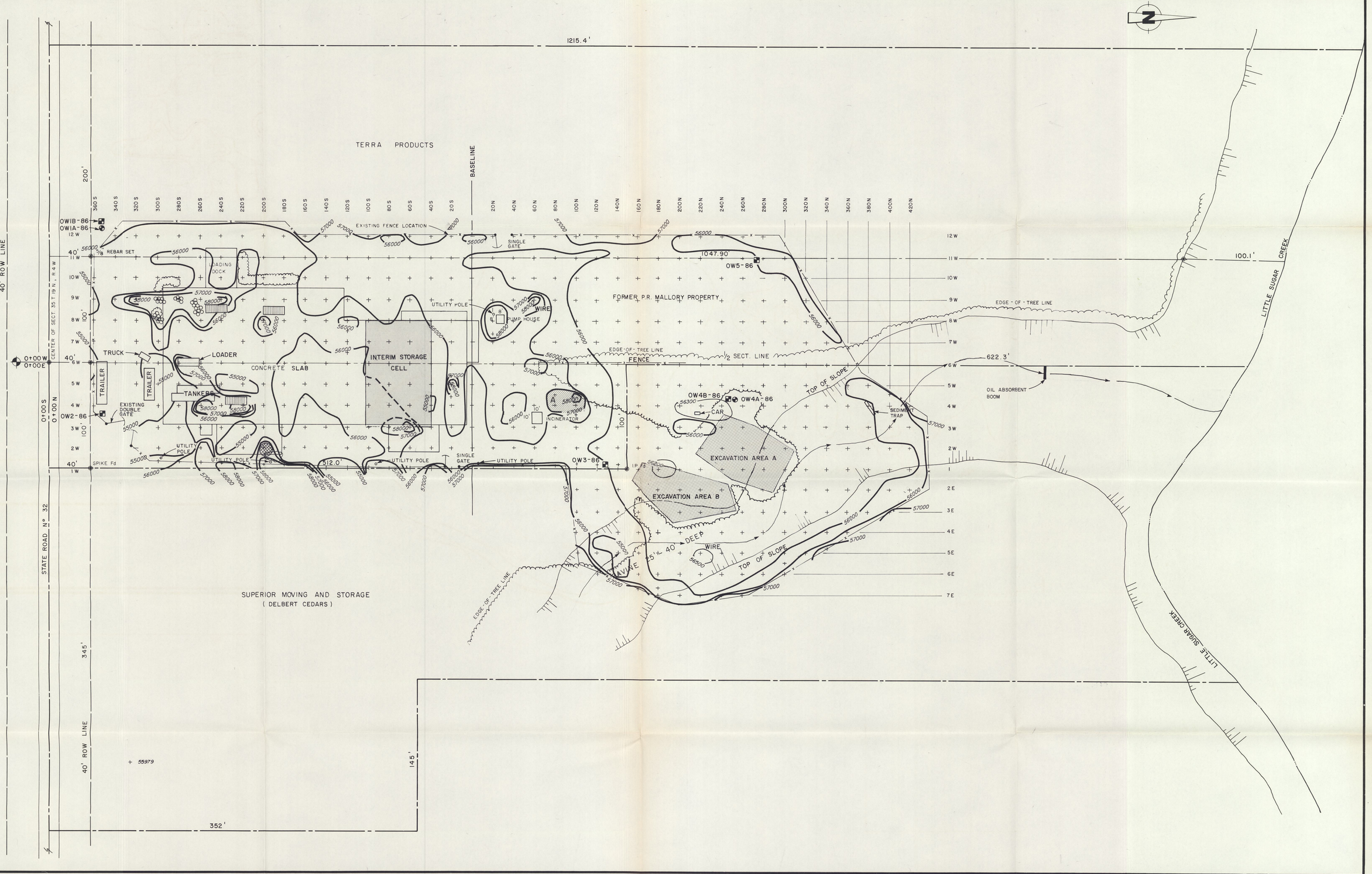
Station	Reading 1	Reading 2	Average	Comments
1	54990	53891	54440	
2 W	55863	55863	55863	
3 W	56019	56020	56019	
4 W	56048	56047	56048	
5 W	56062	56062	56062	
6 W	56040	56039	56040	
7 W	55726	55724	55725	
7 1/2 W	55379	55384	55381	
8 W	56031	56030	56030	
9 W	55922	55923	55922	
10 W	56114	56110	56112	
11 W	56046	56051	56048	
12 W	56929	56843	56886	

LINE +340 S

Station	Reading 1	Reading 2	Average	Comments
4 W	55945	55552	55749	
5 W				U-haul over point
6 W	55199	55195	55197	
7 W	55719	55747	55733	
8 W	55539	55529	55534	
9 W	56980	56891	56936	drums
10 W	55871	55873	55872	
11 W	55804	55803	55804	
12 W	56675	58029	57352	

LINE +360 S

Station	Reading 1	Reading 2	Average	Comments
4 W	55707	55934	55821	trailer
5 W	54693	55530	55112	trailer
6 W	54580	54896	54738	trailer
7 W	54768	55858	55313	
8 W	55339	55770	55555	
9 W	54958	55843	54000	



LEGEND

- OBSERVATION WELL (SHALLOW)
- OBSERVATION WELL (DEEP)
- SCRAP PILE
- WASTE CONTAINER
- DRUMS
- ANAMALOUS ZONES

Nº	Revision	Date	Initial
1	ISSUED FOR CONSTRUCTION	NOV. 14, 1986	

Approved

FORMER P.R. MALLORY PLANT SITE
CRAWFORDSVILLE, IND.

MAGNETOMETER SURVEY

CRA Consulting Engineers
CONESTOGA-ROVERS & ASSOCIATES
651 Colby Drive, Waterloo, Ontario Canada N2V 1C2

Drawn by: B.L.P.	Scale: 1" = 40'	Date: JANUARY 1987	File Nº: 39	Rev. Nº: 1
Designed by: J.C.				
Checked by: R.T.P.	Field book:	Project Nº: 1916	Drawing Nº: 10 PLAN 1	